Mossy Creek, Long Glade Run and Naked Creek

Water Quality Improvement Plan

A plan to reduce bacteria and sediment in the creeks

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1. INTRODUCTION

1.1 Background

The Clean Water Act (CWA) that became law in 1972 requires that all U.S. streams, rivers, and lakes meet their state's water quality standards. The CWA also requires that states conduct monitoring to identify polluted waters or those that do not meet standards. Through this required program, the state of Virginia has found that many streams do not meet state water quality standards for protection of the five beneficial uses: fishing, swimming, shellfish, aquatic life, and drinking.

When streams fail to meet standards, Section 303(d) of the CWA and the U.S. Environmental Protection Agency's (EPA) Water Quality Management and Planning Regulation both require that states develop a Total Maximum Daily Load (TMDL) for each pollutant. A TMDL is a "pollution budget" for a stream. That is, it sets limits on the amount of pollution that a stream can tolerate and still maintain water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. A TMDL accounts for seasonal variations and must include a margin of safety. Through the TMDL process, states establish water-quality based controls to reduce pollution and meet water quality standards.

Once a TMDL is developed, measures must be taken to reduce pollution levels in the stream. Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA) states that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters". A TMDL Implementation Plan describes control measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), to be implemented in order to meet the water quality goals established by the TMDL.

1.2 Applicable Water Quality Standards

Water quality standards are designed to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.)."

Virginia Water Quality Standard 9 VAC 25-260-10 (Designation of uses.) states:

A. All state waters, including wetlands, are designated for the following uses: recreational uses, e.g., swimming and boating; the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them; wildlife; and the production of edible and marketable natural resources, e.g., fish and shellfish.

♦

D. At a minimum, uses are deemed attainable if they can be achieved by the imposition of effluent limits required under §§301(b) and 306 of the Clean Water Act and cost-effective and reasonable best management practices for nonpoint source control.

♦

G. The [State Water Quality Control] board may remove a designated use which is not an existing use, or establish subcategories of a use, if the board can demonstrate that attaining the designated use is not feasible because:

1. *Naturally occurring pollutant concentrations prevent the attainment of the use;*
2. *Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating state water conservation requirements to enable uses to be met;*

♦

6. *Controls more stringent than those required by §§301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.*

At the time when Mossy Creek, Long Glade Run and Naked Creek were listed as impaired, the State's water quality criterion for fecal bacteria was based on fecal coliform. For a non-shellfish supporting waterbody to be in compliance with Virginia fecal coliform standard for contact recreational use, VADEQ specified the following criteria (Virginia Water Quality Standard 9 VAC 25-260-170):

A. *General requirements. In all surface waters, except shellfish waters and certain waters addressed in subsection B of this section, the fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a 30-day period, or a fecal coliform bacteria level of 1,000 per 100 ml at any time.*

If the waterbody exceeded either criterion more than 10% of the time, the waterbody was classified as impaired and a TMDL was developed and implemented to bring the waterbody into compliance with the water quality criterion. Based on the sampling frequency, only one criterion was applied to a particular datum or data set (Virginia Water Quality Standard 9 VAC 25-260-170). If the sampling frequency was one sample or less per 30 days, the instantaneous criterion was applied; for a higher sampling frequency, the geometric criterion was applied. The instantaneous fecal coliform water quality standard was modified in 2003 to a level of 400 colony forming units (cfu) per 100 ml.

Sufficient fecal coliform bacteria standard violations were recorded at VADEQ water quality monitoring stations to indicate that the recreational use designations are not being supported (VADEQ, 1998). Most of the VADEQ's ambient water quality monitoring is done on a monthly or quarterly basis. This sampling frequency does not provide the two or more samples within 30 days needed for use of the geometric mean part of the standard. Therefore, VADEQ used the 1,000 cfu/100 mL standard in the 1996, 1998 and 2002 303(d) assessments for the fecal coliform bacteria monitoring data. The 400 cfu/100 ml standard was used in the 2004 Section 303(d) assessments for the fecal coliform bacteria monitoring data.

At the time when the Naked Creek TMDL was developed (2002) the State's water quality criterion for fecal bacteria was still based on fecal coliform. Consequently, the TMDL was developed to meet the fecal coliform standard. The Mossy Creek and Long Glade Run TMDLs were developed in 2004, and were both designed to meet the *E. coli* standard that became effective January 15, 2003. The EPA recommended that all states adopt an *E. coli* or *enterococci* standard for fresh water and *enterococci* criteria for marine waters by 2003. The EPA is pursuing the states' adoption of these standards because there is a stronger correlation between the concentration of these organisms (*E. coli* and *enterococci*) and the incidence of gastrointestinal illness than with fecal coliform. *E. coli* and *enterococci* are both bacteriological organisms that can be found in the intestinal tract of warm-blooded animals. Like fecal coliform bacteria, these organisms indicate the presence of fecal contamination. For a non-shellfish supporting waterbody to be in compliance with Virginia's Esherichia coli standard for contact recreational use, VADEQ specified the following revised criteria:

> *E. coli bacteria concentrations for freshwater shall not exceed a geometric mean of 126 counts per 100 mL for two or more samples taken during any calendar month and shall not exceed an instantaneous single sample maximum of 235 cfu/100 mL.*

In addition to violating the fecal bacteria standard, Mossy Creek was also found to be in violation of the general standard for aquatic life use. This aquatic life use impairment designation was based upon data collected through VADEQ's Biological Monitoring Program. VADEQ has designed this monitoring program around the USEPA Rapid Bioassessment Protocol II. Benthic samples are collected in the spring and the fall, and a water quality rating of "slightly impaired," moderately impaired," or "severely impaired" is produced for each sample. Any stream segment with an overall rating of ," moderately impaired," or "severely impaired" is placed on the state's 303(d) list of impaired streams (VADEQ, 2002).

1.3 Water Quality Standard Changes

Two regulatory actions related to the bacteria water quality standard in Virginia have been implemented. The first rulemaking action was the change in indicator species used to measure bacteria pollution from fecal coliform to *E. coli*. The second rulemaking action is an evaluation of the designated uses as part of the state's triennial review of its water quality standards. All waters in the Commonwealth have been designated as "primary contact" for the swimming use regardless of size, depth, location, water quality or actual use. The fecal coliform bacteria standard described in Section 1.2 of this report is to be met during all stream flow levels and was established to protect bathers from ingestion of potentially harmful bacteria. However, many headwater streams are small and shallow during base flow conditions when surface runoff has minimal influence on stream flow. Even in pools, these shallow streams do not allow full body immersion during periods of base flow. In larger streams, lack of public access often precludes the swimming use.

Recognizing that all waters in the Commonwealth are not used extensively for swimming, Virginia has approved a process for re-designation of the swimming use for secondary contact in cases of: 1) natural contamination by wildlife, 2) small stream size, and 3) lack of accessibility to children, as well as due to widespread socio-economic impacts resulting from the cost of improving a stream to a "swimmable" status.

The re-designation of the current swimming use in a stream will require the completion of a Use Attainability Analysis (UAA). A UAA is a structured scientific assessment of the factors affecting the attainment of the use, which may include physical, chemical, biological, and economic factors as described in the Federal Regulations. The stakeholders in the watershed, Virginia, and EPA will have an opportunity to comment on these special studies.

In some streams for which TMDLs have been developed, water quality modeling indicates that even after removal of all of the sources of *E. coli* (other than wildlife), the stream will not attain standards. TMDL allocation reductions of this magnitude are not realistic and do not meet EPA's guidance for reasonable assurance. Based on the water quality modeling, many of these streams will not be able to attain standards without some reduction in wildlife. Virginia and EPA are not proposing the reduction of wildlife to allow for the attainment of water quality standards. This is obviously an impractical action. While managing over-populations of wildlife remains as an option to local stakeholders, the reduction of wildlife or changing a natural background condition is not the intended goal of a TMDL. In such a case, after demonstrating that the source of *E. coli* contamination is natural and uncontrollable by effluent limitations and BMPs, the state may decide to re-designate the stream's use for secondary contact recreation or to adopt site specific criteria based on natural background levels of *E. coli*. The state must demonstrate that the source of *E. coli* contamination is natural and uncontrollable by effluent limitations and BMPs through a UAA as described above. All site-specific criteria or designated use changes must be adopted as amendments to the water quality standards regulations. Watershed stakeholders and EPA will be able to provide comment during this process.

2. STATE AND FEDERAL REQUIREMENTS FOR IMPLEMENTATION PLANS

There are a number of state and federal requirements and recommendations for TMDL IPs. The goal of this chapter is to clearly define what they are and explicitly state if the "elements" are a required component of an approvable IP or are merely a recommended topic that should be covered in a thorough IP. This chapter has three sections that discuss a) the requirements outlined by the WQMIRA that must be met in order to produce an IP that is approvable by the Commonwealth, b) the EPA recommended elements of IPs, and c) the required components of an IP in accordance with Section 319 guidance.

2.1 State Requirements

The TMDL IP is a requirement of Virginia’s 1997 Water Quality Monitoring, Information, and Restoration Act (§62.1-44.19:4 through 19:8 of the Code of Virginia), or WQMIRA. WQMIRA directs the SWCB to “develop and implement a plan to achieve fully supporting status for impaired waters.” In order for IPs to be approved by the Commonwealth, they must meet the requirements as outlined by WQMIRA. WQMIRA requires that IPs include the following:

- date of expected achievement of water quality objectives,
- measurable goals,
- necessary corrective actions, and
- associated costs, benefits, and environmental impact of addressing the impairment.

2.2 Federal Recommendations

Section 303(d) of the CWA and current EPA regulations do not require the development of implementation strategies. The EPA does, however, outline the minimum elements of an approvable IP in its 1999 *Guidance for Water Quality-Based Decisions: The TMDL Process*. The listed elements include:

- a description of the implementation actions and management measures,
- a time line for implementing these measures,
- legal or regulatory controls,
- the time required to attain water quality standards, and
- a monitoring plan and milestones for attaining water quality standards.

It is strongly suggested that the EPA recommendations be addressed in the IP, in addition to the required components as described by WQMIRA.

2.3 Requirements for Section 319 Fund Eligibility

The EPA develops guidelines that describe the process and criteria used to award CWA Section 319 nonpoint source grants to States. The guidance is subject to revision and the most recent version should be considered for IP development. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies the following nine elements that must be included in the IP to meet the 319 requirements:

1. Identify the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan;
2. Estimate the load reductions expected to achieve water quality standards;
3. Describe the NPS management measures that will need to be implemented to achieve the identified load reductions;
4. Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan.
5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public's participation in selecting, designing, and implementing NPS management measures;
6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;
7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;
8. Identify a set of criteria for determining if loading reductions are being achieved and if progress is being made towards attaining water quality standards; if not, identify the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of the implementation effort.

3. REVIEW OF TMDL DEVELOPMENT

3.1 Background

Mossy Creek (VAV-B19R) and Long Glade Run (VAV-B24R) were listed as impaired on Virginia's *1996 303(d) Total Maximum Daily Load Priority List and Report* due to violations of the State's water quality standards for fecal coliform (VADEQ, 1996). Mossy Creek was also listed for a benthic impairment in 1998. Naked Creek (VAV-B28R) was added in to the impaired waters list in 1998 for violations of the fecal coliform standard (VADEQ, 1998).

The impaired segments of Mossy Creek (9.65 miles), Long Glade Run (10.7 miles) and Naked Creek (6.75 miles) all run from each stream's headwaters to their confluence with the North River.

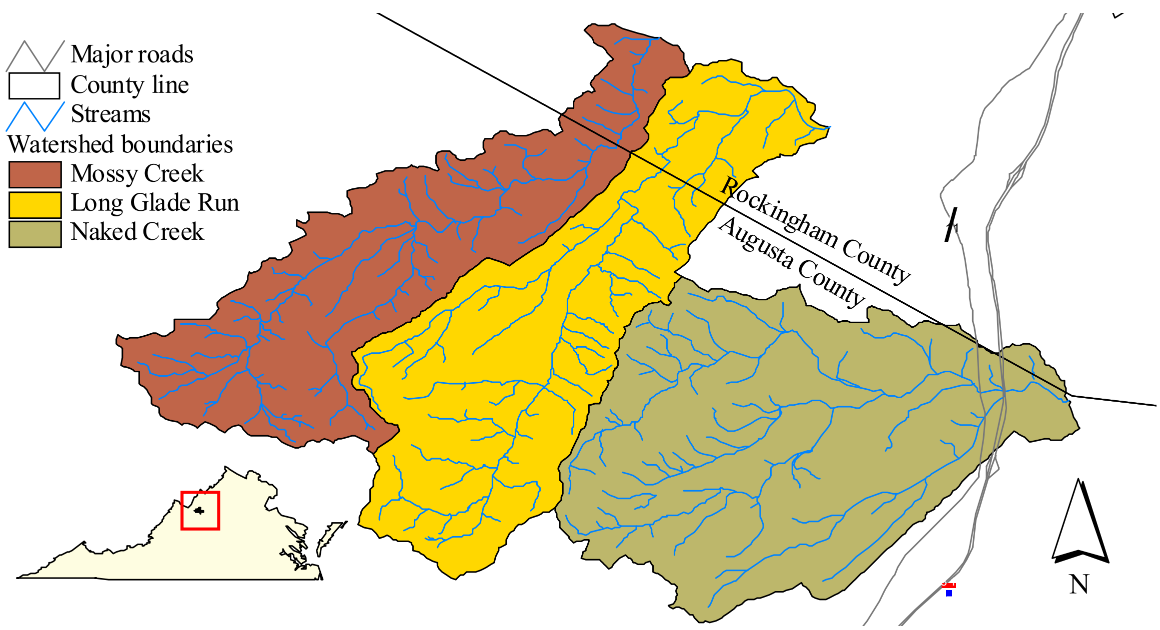

Figure 2.1 Location of Mossy Creek, Long Glade Run and Naked Creek watersheds.

Mossy Creek, Long Glade Run and Naked Creek are part of the Shenandoah River Basin. The Mossy Creek, Long Glade Run and Naked Creek watersheds are approximately 10,077 acres, 11,781 acres and 14,674 acres, respectively.

Land use in all three of the watersheds is predominantly agricultural, ranging from 68% to 75% of each watershed (Table 2.1, Figure 2.1). The remainder of the watersheds is a mix of forest and rural developments.

Table 2.1 Land use acreages in the Mossy Creek, Long Glade Run and Naked Creek drainage areas

Land use acreage (% total area)			
	Agriculture	**Forest**	**Residential**
Mossy Creek	7,179 (71.3%)	2,533 (25.1%)	360 (3.6%)
Long Glade Run	8,862 (74.8%)	2,620 (22.1%)	363 (3.1%)
Naked Creek	10,104 (68.9%)	4,333 (29.5%)	237 (1.6%)

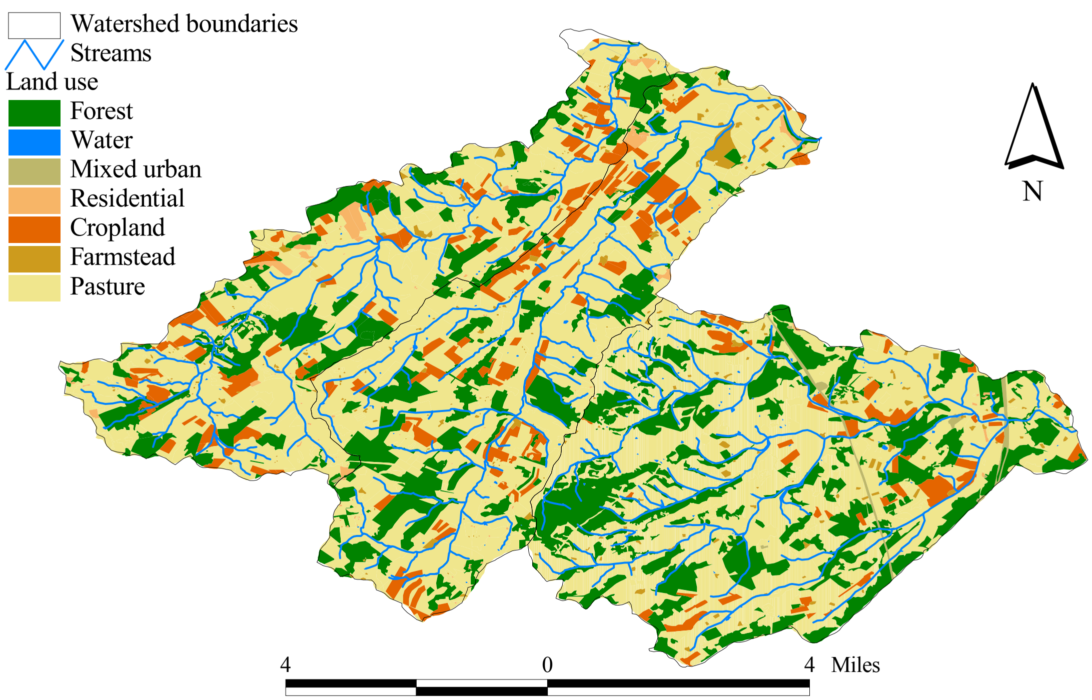

Figure 2.2 Land uses in the Mossy Creek, Long Glade Run and Naked Creek watersheds.

The Department of Biological Systems Engineering from Virginia Tech was contracted to develop the TMDLs for Mossy Creek and Long Glade Run and Naked Creek. The

Naked Creek TMDL was completed in 2002, while the Mossy Creek and Long Glade Run TMDLs were completed in 2004. Both are posted at www.deq.virginia.gov.

3.2 Description of Water Quality Monitoring

The VADEQ currently uses a six-year rotation as the basis for their state-wide ambient water quality monitoring network, which includes such parameters as temperature, dissolved oxygen, specific conductance, pH, bacteria, and nutrients. As part of this system, a station is monitored for two years of every six-year period (two years on, four years off). There is an ambient monitoring station in each of the three watersheds (Table 3.1). Once the TMDL Implementation Plan is complete, VADEQ will shift these monitoring stations out of the rotational schedule and conduct continuous monthly monitoring. Data previously collected from these stations were used to list these streams as impaired by fecal bacteria, and data collected following completion of the implementation plan will be used to monitor water quality improvements and eventually remove the streams from the impaired waters list.

Table 3.1 DEQ Monitoring Stations in the Mossy Creek, Long Glade Run and Naked Creek Watersheds.

Stream Name	Station ID	Location	Frequency	Type of Sampling
Mossy Creek	1BMSS001.35	Rt. 747 Bridge (Rock. Co.)	Monthly	Bacteria and Water Quality Parameters
Long Glade Run	1BLGC000.96	Rt. 727 Bridge	Monthly	Bacteria and Water Quality Parameters
Naked Creek	1BNKD000.80	Rt. 994 Bridge	Monthly	Bacteria and Water Quality Parameters
Mossy Creek	1BMSS003.01	Rt. 747 Bridge (Aug. Co.)	Fall/Spring	Biological Monitoring

VADEQ is also conducting biological monitoring in the watersheds in the Fall and Spring each year. These data are used to assess the health of the benthic community. Biological monitoring in Mossy Creek following completion of the implementation plan will be used to measure success in restoration of the benthic community.

3.3 Description of Water Quality Modeling

Bacteria Modeling

The Hydrologic Simulation Program – FORTRAN (HSPF) was used to simulate the fate and transport of fecal coliform bacteria in the Mossy Creek, Long Glade Run and Naked Creek watersheds. To clearly identify sources of fecal coliform and sediment, each watershed was divided up into smaller subwatersheds (Figure 3.1).

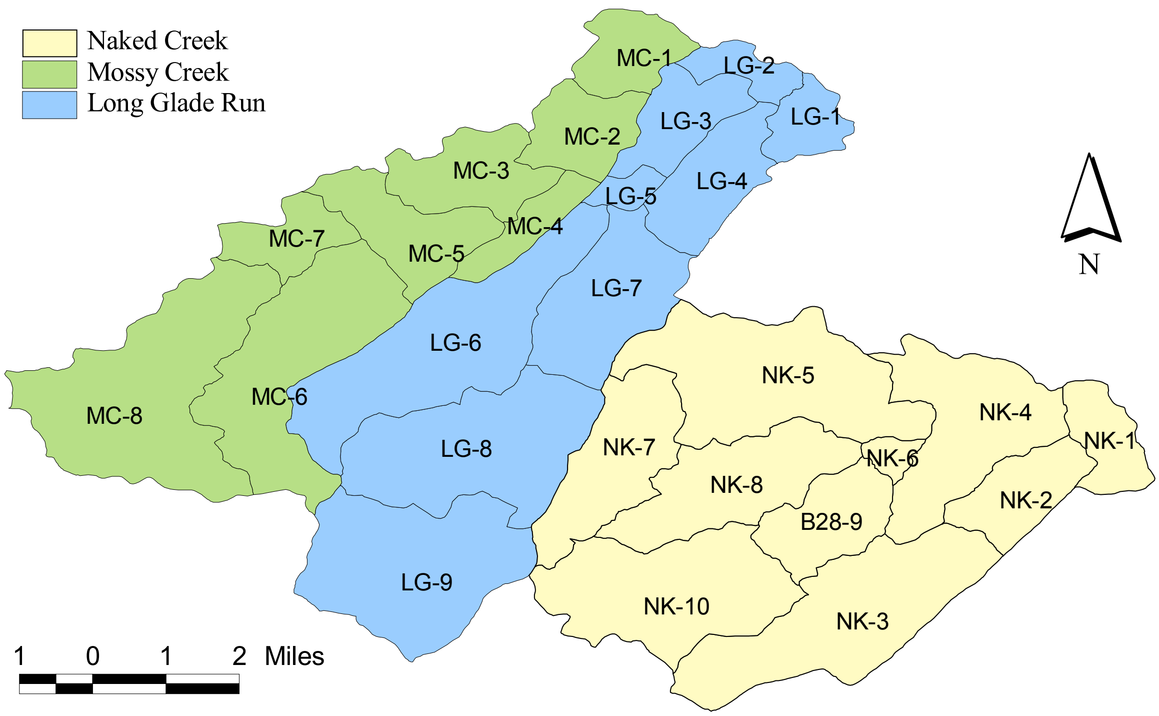

Figure 3.1 Subwatersheds used for TMDL development in Mossy Creek, Long Glade Run and Naked Creek

Sediment Modeling

During development of the benthic TMDL for Mossy Creek, sediment was identified as the primary stressor of the benthic community. Because Virginia has no numeric in-stream criteria for sediment, a “reference watershed” approach was used to define allowable TMDL sediment loading rates in the impaired watershed. The reference watershed approach pairs two watersheds: one whose streams are supportive of their designated uses and one whose streams are impaired. This approach is based on the assumption that reduction of the stressor loads in the impaired watershed to the level of the loads in the reference watershed will result in restoration of the benthic community to a "non-impaired" state. The reference watershed approach involves selection of an appropriate reference watershed, model parameterization of the reference and TMDL watersheds, and definition of the TMDL endpoint using modeled output from the reference watershed.

The Upper Opequon Creek watershed was selected as the reference watershed for the Mossy Creek TMDL. The TMDL sediment target load was defined as the modeled sediment load for existing conditions from the non-impaired Upper Opequon watershed, area-adjusted to the Mossy Creek watershed.

The Generalized Watershed Loading Function (GWLF) model (Haith et al., 1992) was selected for comparative modeling of the sediment loads in the impaired and reference watersheds in the TMDL study. Model parameter values were comparably evaluated using the same data sources and procedures recommended in the GWLF Users Manual (Haith et al., 1992) for the land uses and conditions found in these watersheds.

3.4 Description of Sources Considered

Potential sources of bacteria and sediment considered in the development of the TMDLs included both point source and nonpoint source contributions.

Point Sources

A TMDL's waste load allocation accounts for the portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Point sources of fecal coliform bacteria in the watersheds include all municipal and industrial plants that treat human waste, as well as private residences that fall under general permits. Virginia issues Virginia Pollutant Discharge Elimination System permits for point sources. The point sources of bacteria and sediment in the watersheds are listed in Table 3.2, along with their permitted discharges and load allocations in the TMDLs. The waste load allocation for each point source was set at the permitted load.

Table 3.2 General permits discharging fecal coliform and sediment into Mossy Creek, Long Glade Run and Naked Creek

Permit #	Description	Subwatershed	Fecal coliform load (cfu/100 mL)	TSS load (t/yr)
VAG401165	Residential	NK-1	2.76×10^9	N/A
VAG401545	Residential	NK-2	2.76×10^9	N/A
VAG401481	Residential	LG-1	2.76×10^9	0.0415
VAG401919	Residential	LG-1	2.76×10^9	0.0415
VAG401746	Residential	LG-7	2.76×10^9	0.0415
VAG401083	Residential	MC-7	2.76×10^9	0.0415

Nonpoint sources

Nonpoint source pollution originates from sources across the landscape (e.g., agriculture and urban land uses) and is delivered to waterbodies by rainfall and snowmelt. In some cases, a precipitation event is not required to deliver nonpoint source pollution to a stream (e.g., pollution from leaking sewer lines or livestock directly defecating in a stream). Nonpoint sources of bacteria in the watersheds included residential sewage treatment systems, land application of waste, livestock, wildlife, and domestic pets. Nonpoint sources of sediment considered in the Mossy Creek watershed included runoff from agricultural, residential, forestry and urban land uses. In addition, stream channel and bank erosion were considered. Streambank erosion occurs when streamside or “riparian” vegetation is removed. This results in streambank instability, which causes portions of the banks to erode way into the stream. Animals grazing on pastures in riparian areas with access to streams also contribute to streambank erosion as they climb up and down the banks. Stream channel erosion results from increased runoff rates related to human activities in the watershed, particularly increasing paved impervious areas in the watershed due to urban growth and development. The bacteria and sediment sources are summarized in Tables 3.3 and 3.4 respectively. The Pasture 1 and Pasture 2 land uses listed under sources in Table 3.3 refer to the condition and livestock stocking densities on pasture. Pasture 1 is defined as “improved” pasture/hay and has twice the stocking density as Pasture 2. Pasture 2 is considered “unimproved”. Loafing lots are areas that receive considerable traffic from livestock, and may be used for herd exercise and loafing. These areas often become denuded of vegetation and can contribute significant sediment and bacteria loads to streams.

Table 3.3 Annual nonpoint source fecal coliform loads

Source		**Annual Nonpoint Source Load (x 10^{12} cfu)**		
		Mossy Creek	**Long Glade Run**	**Naked Creek**
Land-based loads	Cropland	666	572	24.4
	Pasture 1	48,891	45,055	1,976
	Pasture 2	2,622	3,673	1,795
	Livestock loafing lots	852	1,142	-----
	Residential	238	206	31.7
	Forest	103	92.3	1.5
Direct loads	Cattle in streams		55.7	31.3
	Wildlife in streams	12.5	2.5	1.2
	Straight pipes	3.4	-----	0.6
Total		**53,576.9**	**50,798.5**	**3,861.7**

Table 3.4 Annual nonpoint source sediment load in Mossy Creek

Annual Nonpoint Source Load (t/yr)						
Cropland	**Pasture**	**Urban**	**Forestry**	**Channel Erosion**	**Point Sources**	**Total**
17,621.5	1,358	81.7	96.4	1,227.2	0.04	**20,385**

Loads were represented either as land-based loads (where they were deposited on land and available for wash off during a rainfall event) or as direct loads (where they were directly deposited to the stream). Land-based nonpoint sources are represented as an accumulation of bacteria or sediment on the land, where some portion is available for transport in runoff. The amount of accumulation and availability for transport vary with land use type and season. In the case of bacteria, the HSPF model allows a maximum accumulation to be specified. The maximum accumulation was adjusted seasonally to account for changes in die-off rates, which are dependent on temperature and moisture conditions. Direct loads such as straight pipes are modeled similarly to point sources since they do not require a runoff event for delivery to the stream.

Influence of Freemason Run on Sediment Loading in Mossy Creek

Four major springs are located in the Mossy Creek watershed: Mount Solon Spring, Blue Hole, Cress Pond and Kyle's Mill Series. It is estimated that flows from these springs may constitute up to 80% of the flow in Mossy Creek (VA Tech, 2004). The influence of these springs on both fecal coliform and sediment loading was investigated in the development of the Mossy Creek and Long Glade Run TMDL in 2004. Water quality sampling was conducted by the Virginia Tech Biological Systems Engineering Department between 2002 and 2003. While sampling indicated that the springs were a minor source of fecal coliform in the watershed, there was no indication that they were a significant source of sediment. Consequently, the spring flows were not assigned a sediment load when considering total suspended solids (TSS) in the modeling process for the Mossy Creek and Long Glade Run TMDL study.

Concerns have since been expressed by the local community and state agencies about the validity of this TSS data due to the method in which it was collected. In order to determine whether the springs are a significant source of sediment in the watershed, it is imperative that sampling be conducted during storm events. Due to the nature of karst systems, sediment deposits may be stored in solution channels and flushed out during high flows. Consequently, baseflow sampling would not provide an accurate assessment of sediment loading in Mossy Creek from the springs.

The Virginia Departments of Conservation and Recreation and Environmental Quality in collaboration with the Department of Integrated Science and Technology at James Madison University conducted a small-scale study of the influence of two springs on sediment loading in Mossy Creek in the summer of 2007 (Figure 3.2). Dye tracer studies conducted by the DCR Karst Program indicated that the North River and Freemason Run are connected to the Mount Solon Spring. Freemason Run sinks several hundred feet upstream of its intersection with the North River, and flows south under a topographic divide to the Mount Solon Spring at the headwaters of Mossy Creek (DCR Karst Program, personal communication). It is hypothesized that Freemason Run is a large contributor of sediment to Mossy Creek through the Mount Solon Spring. Consequently, the Mount Solon Spring was sampled along with the Cress Pond Spring, which served as a control for the study. Due to the lack of rain that occurred over the summer, it proved difficult to capture a significant storm event during the study period. Additional research will be needed in order to draw a definite conclusion about the influence of Freemason Run on Mossy Creek. However, it was decided that cost share funding for agricultural BMPs that was originally allocated only for Mossy Creek, Long Glade Run and Naked Creek could also be used for BMPs in Freemason Run until a definite conclusion can be drawn.

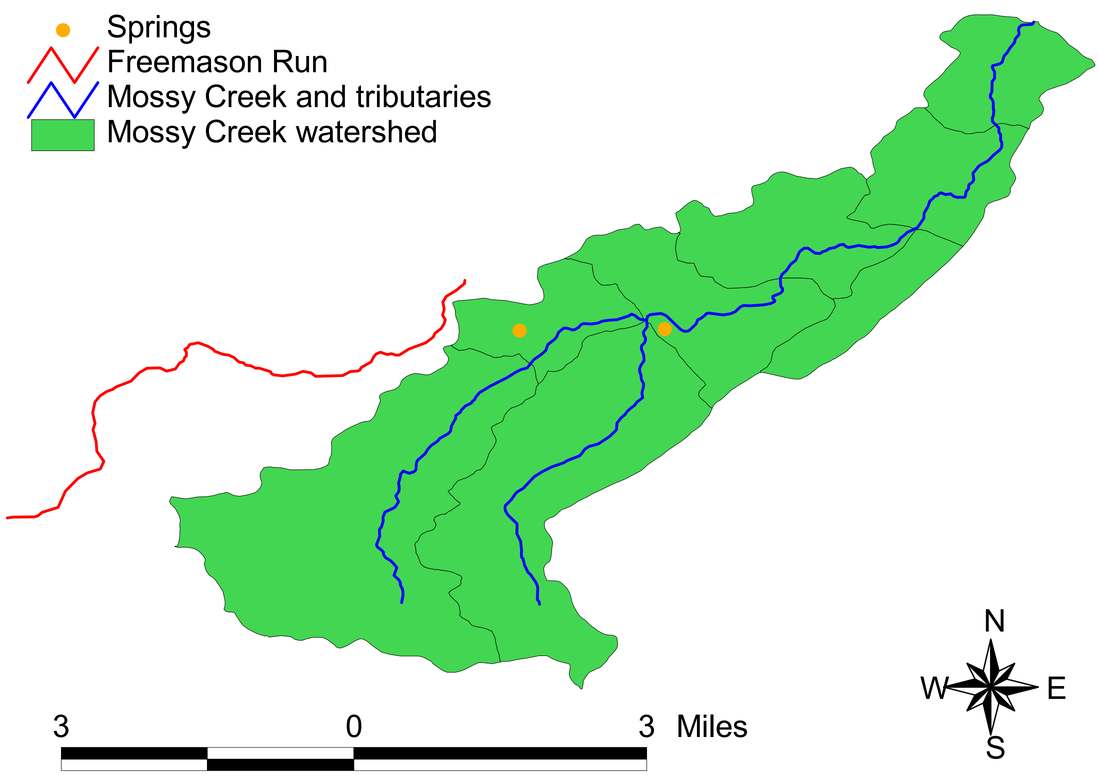

Figure 3.2 Springs sampled in Mossy Creek spring study

TMDL Allocation Scenarios

Bacteria TMDLs: Mossy Creek, Long Glade Run and Naked Creek

Each bacteria TMDL included a series of reduction scenarios for fecal coliform in order to meet the fecal coliform standard in Naked Creek and the *E. coli* standard in Mossy Creek and Long Glade Run. In order to develop the Mossy Creek and Long Glade Run *E. coli* TMDLs, the fecal coliform data collected in prior years from the streams needed to be converted to *E. coli* concentrations. VADEQ has developed a procedure to be followed in this situation. The necessary modeling was conducted using fecal coliform loadings as the bacteria source in the watershed. Then an equation developed by VADEQ was used to convert the daily average fecal coliform concentrations output by the model to daily average *E. coli* concentrations. The equation is:

$$E.\ coli \text{ concentration} = 2^{-0.0172} \text{ x (FC concentration)}^{0.91905}$$

where the bacteria concentrations (*E. coli* and FC) are in cfu/100 mL. After applying the equation to the output from the HSPF model, daily E. coli loads were determined by multiplying the daily concentrations by the average daily flow. Average annual load was determined by summing the daily loads and dividing by the number of years in the allocation period.

Different scenarios were evaluated to identify scenarios for implementation that meet both the calendar-month geometric mean bacteria standard (126 cfu/100 mL for *E. coli,* 200 cfu/100 mL for fecal coliform) and the single sample maximum bacteria standard (235 cfu/100 mL for *E. coli,* 1000 cfu/100 mL for fecal coliform) with zero violations. The MOS (margin of safety) was implicitly incorporated into each TMDL by conservatively estimating several factors affecting bacteria loadings, such as animal numbers, production rates, and contributions to streams. A preferred scenario was selected by a technical advisory committee for each watershed during the TMDL development process (Table 3.5).

Table 3.5 Bacteria reduction scenarios for the Mossy Creek, Long Glade Run and Naked Creek watersheds (DD=direct deposit, PLS=pervious land surface)

Watershed	Fecal Coliform Reduction from Source Category (%)						
	Cattle DD	Cropland	Pasture	Loafing Lot	Wildlife	Straight Pipes	All Residential PLS
Mossy Creek	94%	95%	98%	100%	0%	100%	95%
Long Glade Run	99%	95%	95%	100%	30%	100%	30%
Naked Creek	100%	0%	97%	N/A	55%	100%	85%

Benthic TMDL: Mossy Creek

The benthic TMDL for Mossy Creek provided a series of reduction scenarios for sediment in the watershed. Reduction scenarios for sediment loadings were developed by placing nonpoint source sediment loads into six categories: cropland, pasture, urban, forestry, channel erosion, and point sources. An margin of safety was defined as 10% of the calculated TMDL. Permits to discharge suspended solids into the stream (Table 3.2) were summed to develop a waste load allocation. No reductions were assigned to this sediment waste load. The load allocation (the allowable sediment load from nonpoint sources) was calculated as the target TMDL load minus the margin of safety minus the waste load allocation. Reduction scenarios were evaluated by VADEQ and a technical advisory committee. The scenario selected for the TMDL is shown in Table 3.6.

Table 3.6 Sediment reduction scenario for the Mossy Creek watersheds

Sediment Reduction from Source Category (%)				
Cropland	Pasture	Urban	Forestry	Channel Erosion
75%	75%	75%	75%	75%

3.5 Implications of TMDLs on the Implementation Plan

Based on the bacteria and sediment reductions developed for these TMDLs, it is clear that extreme reductions will be needed to meet the water quality standard for bacteria and restore the benthic community. All uncontrolled discharges, failing septic systems, leaking sewer lines, and overflows must be identified and corrected; most livestock must be excluded from streams, in some cases loads from wildlife must be reduced, and urban and rural nonpoint sources must be reduced.

However, there are subtler implications as well. Implicit in the requirement for 100% correction of uncontrolled discharges is the need to maintain all functional septic systems. **Wildlife direct deposition will not be explicitly addressed by this implementation plan. All efforts will be directed at controlling anthropogenic sources.**

4. PUBLIC PARTICIPATION

Collecting input from the public on conservation and outreach strategies to include in the TMDL Implementation Plan was a critical step in this planning process. Since the plan will be implemented primarily by watershed stakeholders on a voluntary basis with some financial incentives, local input and support are the primary factors that will determine the success of this plan.

4.1 Public Meetings

A public meeting was held on the evening of June 20th, 2007 at the North River Elementary School meeting to kick off the development of the implementation plan. This meeting served as an opportunity for local residents to learn more about the creeks, and to work together to come up with new ideas to protect and restore water quality in their community. The meeting began with a brief presentation on existing water quality conditions in the streams, and what types of actions and information could be included in implementation plan to improve water quality. Following the presentation, attendees split up into two working groups: a residential group and an agricultural group. The working groups discussed how residential and agricultural land use practices are affecting the quality of these streams, and reviewed different land use management practices that could be included in the clean up plan. These discussions were facilitated by TMDL staff from Virginia's Department of Environmental Quality and Department of Conservation and Recreation. The kick off meeting was publicized through email announcements, mailings, fliers and signs posted throughout the watershed. and was attended by 33 people, including citizens, government agents, local businessmen, and a representative from a non profit organization.

The final public was held on June 18, 2009 at North River Elementary School, located in the Mossy Creek watershed. The primary purpose of this meeting was to present the final TMDL Implementation Plan. Postcards were mailed out to landowners in the watershed to notify them of the meeting. In addition, signs were posted in each of the three watersheds to let residents know about the meeting. A presentation was given by Tara Sieber of VADEQ describing the implementation plan and its major components. A draft implementation plan was distributed to attendees. In addition, informational pamphlets describing programs associated with the Headwaters SWCD, VADCR, and VADEQ were made available. Partner agencies and organizations were invited to set up displays around the room in order to provide attendees with a comprehensive picture of existing conservation efforts in the watersheds.

4.2 Agricultural Working Group

The role of the Agricultural Working Group was to review conservation practices and outreach strategies from an agricultural perspective, identify any obstacles (and solutions) related to BMP implementation, and to provide estimates on the type, number, and costs of BMPs. During the first agricultural working group meeting on June 20^{th}, the group began by expressing their concerns that more water quality monitoring needed to occur in Mossy Creek prior to the development of an implementation plan for the watershed. Due to the rotational monitoring schedule used by VADEQ, bacteria has not been monitored in Mossy Creek since 2003. The working group felt that perhaps more improvements had been made in the watershed since then, and were reluctant to develop a plan that was based on the older monitoring data. The group discussed the possibility of forming a volunteer group to conduct Coliscan Easygel© monitoring in the Mossy Creek watershed.

A second agricultural working group meeting was held on October 4, 2007. During this meeting, the working group discussed livestock exclusion fencing needs for the implementation plan. The group agreed that just getting cows out of the creek is beneficial for water quality, but was concerned that the current state and federal program requirement of a 35-ft buffer as well will be problematic for farmers. The Headwaters Soil and Water Conservation District is working with the Shenandoah Resource Conservation and Development (RC&D) and other partners to implement an alternative fencing program in the watersheds that does not require a setback. All that is required of the landowner is to fence cattle out of the streams and maintain the fence for five years. The group also discussed maintenance issues with riparian buffers and current pasture management practices in the watersheds. The group agreed that buffer maintenance needs frequently deter individuals from signing up for state and federal conservation programs.

4.3 Residential Working Group

The primary role of the Residential Working Group (RWG) was to discuss methods needed to reduce human and pet sources of bacteria entering the creeks, recommend methods to identify and correct or replace failing septic systems and straight pipes, and provide input on the BMPs to include in the plan.

A second residential working group meeting was held on September 9, 2007. The group discussed opportunities for financial assistance with septic system repairs and replacements, which are available through the Headwaters Soil and Water Conservation District and the Augusta County Service Authority through 2009. The group suggested that the septic tank pumpout portion of this program should be focused on homes that are 5 years or older and within 500 ft of a stream. Postcards, letters and a bulletin/newsletter were identified as effective outreach methods. A participant also suggested implementing a well-testing program. Augusta County adopted an ordinance in July 2007 that requires a maintenance agreement between the County and all homeowners with alternative systems. This ordinance requires property owners with alternative systems to procure an annual inspection of their system and provide documentation of this inspection to the Health Department. Property owners are also required to provide notice to subsequent owners that their home is serviced by an alternative system. The group estimated that approximately 20-25% of all systems in the watersheds are alternative systems.

Pet waste digesters were identified as a great idea in urban areas, though the working group thought that people living in these more rural watersheds would probably not use them. The group agreed that the digesters could be a unique method to focus on small, riparian communities in the watersheds, and recommended having a few available to target with pump-out program, but to otherwise focus on the education of homeowners (pick up waste with plastic bags, etc). It was determined that although there are no public parks or dog-walking areas so no pet-waste pick-up stations would be needed. There is a kennel/veterinary clinic in the Naked Creek watershed called Maple Lane Veterinary Clinic. The working group suggested contacting them about how to dispose of their waste material.

The group discussed specific locations for riparian buffers and rain gardens. They decided that the TMDL Technicians could aim for 5 small raingardens in each watershed. The group though that the vet clinic in Naked Creek would be a good place for a riparian buffer since they own land right down to the stream. Tyco in Mt. Sidney, which is not very close to the stream, but does drain to Naked Creek, could be a great place for a rain garden. Oak Manor Horse Center in Burketown was sold to Bridgewater College recently, and the property abuts Naked Creek. This would be a good site for a riparian buffer.

4.4 Government Working Group

The goals of the Government Working Group (GWG) were to identify regulatory controls currently in place in the watersheds that may help to improve water quality (*e.g.,* livestock stream access and sewer line connections), to identify existing programs and technical resources that may enhance implementation efforts, and to propose additional programs that would support implementation. A single Government Working Group was held with conservation agency representatives on December 9, 2008. DCR and DEQ staff shared estimates developed for the extent and cost of best management practices needed to meet the TMDL. The working group discussed both state and federal agricultural cost share programs, and NRCS and Headwaters SWCD staff made recommendations based on their experiences working with landowners in the watersheds.

There was some discussion of the Stream Protection (WP-2) practice and the impact that hardened crossings and limited access points have on water quality. The group expressed some concerns about the effectiveness of stream exclusion with limited access points, particularly during times when stream flow is very low. There was some discussion of doing additional monitoring, possibly using Coliscan, at access points in the watersheds. This is something that could be done with high school students or students at James

Madison University. The group also discussed the possibility that alternative water sources for livestock could be impacting groundwater levels in agricultural areas.

The group recommended increasing the number of CREP practices included in the plan, as this is a more popular practices than the other fencing practices currently available through cost share programs. The group thought that it was unlikely that many people would be interested in the WP-2T practice since one of the main reasons producers exclude their livestock through cost share programs is so that they can receive financial assistance with installing a well. While the group did not suggest eliminating this practice from the plan entirely, they thought that it should be minimized in terms of number of practices.

There was some discussion of drawbacks expressed by farmers in the watersheds to livestock exclusion fencing, namely flooding. The group thought that Mossy Creek does not tend to come out of its banks quite as often as Long Glade Run and was unsure about Naked Creek. There was some interest expressed in starting a fencing insurance program. It was suggested that it would be helpful if an individual could be kept "on retainer" by the Soil and Water Conservation District and NRCS in order to provide farmers with assistance putting fencing back up or fixing broken pumps on wells etc. This would provide farmers with an additional sense of security that they would have some help if things went wrong.

Next the group discussed manure storage. They recommended dividing it up into poultry litter storage, liquid manure storage and dry manure storage. The estimate for poultry litter storage looked high to the group; they recommended two storage facilities in each watershed (basically half of what was originally estimated). They thought that the only need for liquid manure storage would be for dairies in the watershed that may expand, so a storage facility for liquid manure was included in each watershed. There was considerable discussion about dry storage facilities and when it would be appropriate to cost share on them. The group agreed that 3-4 in each watershed would be reasonable. In sticking with 3-4, they thought that they could probably address some of the cases in the watershed where there was a real water quality problem that could be addressed by moving where the livestock were being fed, fencing the stream out, and providing some manure storage.

The group discussed practices for cropland next. They thought that over 60% of people in the watershed are already doing cover crops. There was significant concern that the sediment load coming from cropland was overestimated. Historically, there was a lot of cropland in Mossy Creek, but it has been reduced. The creek also has an old mill dam that may be contributing to the sediment issue. It was recommended that crop rotation to perennials be included in the plan (SL-1 in the state cost share program) as well as a small amount of contour farming. While most people are already doing this, there are still a few that have yet to implement it.

After cropland, the group brainstormed some innovative practices that would control wildlife. With the knowledge that the state cannot and will not mandated the removal of wildlife as a way to achieve water quality standards, the group discussed other ideas. The District employees, who are hunters themselves, suggested hosting a creative stamping program which could allow someone hunting the three watersheds to have "2 for 1" day through the season or have a landowner sponsor a "Doe Day" for interested sportsmen. Of course, these ideas would have to be approved by the Virginia Department of Game and Inland Fisheries before any plans can be made.

Lastly, the group discussed ideas for education and outreach. It was recommended that more material be made available on livestock health and drinking dirty water through presentations such as those that have been given by Scott Nordstrom, a local veterinarian. The transfer of livestock diseases through creek water was discussed as a way to encourage livestock exclusion. The group talked about the possibility of working with students and professors at James Madison University to see if a project could be done to investigate how easily different diseases could be transferred to herds in a watershed.

5. IMPLEMENTATION ACTIONS

An important part of the implementation plan is the identification of specific best management practices and associated technical assistance needed to improve water quality in the watersheds. Since this plan is designed to be implemented by landowners on a voluntary basis, it is necessary to identify management practices that are both financially and technically realistic and suitable for this particular community. As part of this process, the costs and benefits of these practices must be examined and weighed. Once the best practices have been identified for implementation, we must also develop an estimate of the number of each practice that would be needed in order to meet the water quality goals established during the TMDL study.

5.1 Identification of Best Management Practices

Potential best management practices, their associated costs and efficiencies, and potential funding sources were identified through review of the TMDL, input from the working groups, and literature reviews. Measures that can be promoted through existing programs were identified, as well as those that are not currently supported by existing programs and their potential funding sources. Some best management practices had to be included in order to meet the water quality goals established in the TMDL, while others were selected through a process of stakeholder review and analysis of their effectiveness in these watersheds. These measures are discussed in sections 5.1.1 and 5.1.2, respectively.

5.1.1 Control Measures Implied by the TMDL

The reductions in sediment and bacteria identified by the TMDL study dictated some of the control measures that must be employed during implementation in order to meet the pollutant reductions specified in the TMDL.

Livestock Exclusion

In order to meet the bacteria reductions in direct deposition from livestock, some form of stream exclusion is necessary. Fencing is the most obvious choice; however, the type of fencing, distance from the stream bank, and most appropriate management strategy for the fenced pasture are less obvious. There are currently several different fencing options available through state, federal and private cost share programs. Fencing material requirements, setbacks, contract lengths, and cost share payment amount vary widely between these programs. The inclusion of a setback with streamside vegetation helps to reduce bacteria, as well as sediment and phosphorus, loads in runoff. The incorporation of effective buffers could reduce the need for more costly control measures. From an environmental perspective, the best management scenario would be to exclude livestock from the stream bank 100% of the time and establish permanent vegetation in the buffer area. This prevents livestock from eroding the stream bank, provides a buffer for capturing pollutants in runoff from the pasture, and establishes (with the growth of streamside vegetation) one of the foundations for healthy aquatic life. From a livestock-production perspective, the best management scenario is one that provides the greatest profit to the farmer. Obviously, taking land (even a small amount) out of production is contrary to that goal. However, a clean water source has been shown to improve milk production and weight gain. Clean water will also improve the health of animals (*e.g.,* cattle and horses) by decreasing the incidence of waterborne illnesses and exposure to swampy areas near streams. All of the cost share programs available to farmers for livestock exclusion were considered when estimating fencing needs in the watersheds. Economic and environmental benefits of the different types of fencing (e.g. with setback and streamside vegetation versus top of bank fencing) were weighed when estimating the proportion of fencing that would be accomplished through the various programs available to farmers in the watersheds.

Septic Systems and Straight Pipes

The 100% reduction in loads from straight pipes and failing septic systems is a pre-existing legal requirement. The options identified for correcting straight pipes and failing septic systems included: repair of an existing septic system, installation of a septic system, and installation of an alternative waste treatment system. It is anticipated that a significant portion of straight pipes will be located in areas where an adequate site for a septic drain field is not available. In these cases, the landowner will have to consider an alternative waste treatment system.

5.1.2 Control Measures Selected through Stakeholder Review

In addition to the control measures that were directly prescribed by the TMDL, a number of measures were needed to control fecal bacteria and sediment from land-based sources. Various scenarios were developed and presented to working groups. All scenarios began with the best management practices that were prescribed by the TMDL such as livestock exclusion and eliminating straight pipes. Next, a series of established best management practices were examined by the working groups, who considered both their economic costs and the water quality benefits that they produced. The majority of these practices are included in state and federal agricultural cost share programs that promote conservation. In addition, innovative and site specific practices suggested by local producers and technical conservation staff were considered.

One best management practice that is currently not explicitly included in agricultural cost share programs is pasture management. Through applying improved pasture management techniques, a producer can significantly reduce the amount of sediment and bacteria that runs off of their pasture and into the stream, while increasing their economic gains at a very low investment cost. Four components of this practice were identified: 1) Maintenance of an adequate forage height (suggested 3-inch minimum height) during growing season 2) Implementation of a nutrient management plan including application of lime and fertilizer according to soil test results 3) Mowing of pastures to control woody vegetation 4) Distribution of manure through managed rotational grazing or mechanically (e.g., chain harrow).

The final set of BMPs identified and the efficiencies used in this study to estimate needs are listed in Table 5.1.

Table 5.1 Best management practices and associated pollutant reductions

BMP Type	Description	Bacteria Reduction Efficiency	Sediment Reduction Efficiency	Reference
Res	Septic tank pumpout	5%	------	2
Res	Septic system repair	100%	------	1
Res	Septic system replacement	100%	------	1
Res	Alternative waste treatment	100%	------	1
Res	Pet waste digester	100%	------	4
Res	Rain garden	40%	85%	2,6
Res	Pet waste education program	50%	------	3
Ag	Improved pasture management	50%	50%	5,8
Ag	Riparian buffer	50%	50%	2
Ag	Woodland buffer filter strip	60%	50%	2
Ag	Grassed buffer filter strip	50%	50%	2
Ag	Livestock exclusion	100%	50%	1
Ag	Poultry litter storage	99%	------	7
Ag	Manure storage	80%	------	7
Ag	Loafing lot management system	75%	40%	6,7
Ag	Sod waterway	50%	77%	9
Ag	Conservation tillage	------	LU conversion	6
Ag	Continuous no-till	------	70%	
Ag	Cover crop	N/A	20%	2
Ag	Contour farming	N/A	41%	10
Ag	Permanent veg. cover on cropland	N/A	50%	11

1. Removal efficiency is defined by the practice
2. VADCR and VADEQ TMDL Implementation Plan Development Guidance Manual
3. Modified from Swann, C. 1999. A survey of residential nutrient behaviors in the Chesapeake Bay. Widener Burrows, Inc. Chesapeake Bay Research Consortium. Center for Watershed Protection. Ellicott City, MD. 112pp.
4. Mill and Hawksbill TMDL IP, MapTech, September 13, 2007
5. Commonwealth of Virginia. 2005. Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy. www.naturalresources.virginia.gov/Initiatives/TributaryStrategies/
6. Chesapeake Bay Model version 4.3 BMP efficiencies
7. North River TMDL IP, MapTech, July 5, 2001

8. Bacteria efficiency estimated based on sediment and nutrient efficiency

9. Fiener, P., Auerswald, K. Effectiveness of grassed waterways in reducing runoff and sediment delivery from agricultural watersheds. J. Environ. Qual. 32:927-936 (2003).

10. Borisova, T., D'Souza, G., Khandelwal, N., Benham, B., and M.L. Wolfe. Analysis of sediment reduction strategies for Abrams Creek Benthic TMDL using PredICT software. http://www.cafcs.wvu.edu/RESM/PDF/RESMWP-05-06.pdf. Accessed December 17, 2008.

11. Practice efficiency estimated based on grassed buffer filter strip efficiency based on establishment of vegetative cover using perennial grasses

5.2 Quantification of Control Measures

The quantity of control measures recommended during implementation was determined through spatial analyses, modeling alternative implementation scenarios, and using input from the working groups. Data on land use, stream networks, and elevation were used in spatial analyses to develop estimates of the number of control measures recommended overall, in each watershed, and within smaller subwatersheds. Data from the VADCR Agricultural BMP Database showing where best management practices are already in place in the watersheds were considered when developing these estimates. In addition, census data were used in order to quantify septic system repairs and replacements needed in order to meet the reductions specified in the TMDL. Estimates of the amount of residential on-site waste treatment systems, streamside fencing and number of full livestock exclusion systems were made through these analyses. The quantities of additional control measures were determined through modeling alternative scenarios and applying the related pollutant reduction efficiencies to their associated bacteria and sediment loads.

Implicit in the TMDL is the need to avoid increased delivery of pollutants from sources that have not been identified as needing a reduction, and from sources that may develop over time. One potential for additional sources of the pollutants identified is future residential development. Care should be taken to monitor development and its impacts on water quality. Where residential development occurs, there is potential for additional pollutant loads from pet waste, failing septic systems, sewer line overflows and leaks.

5.2.1 Agricultural Control Measures

Livestock Exclusion BMPs

In order to meet the bacteria and sediment TMDLs, all livestock will need to be excluded from Mossy Creek, Long Glade Run, and Naked Creek. To estimate fencing needs, the stream network was overlaid with land use. Stream segments that flowed through or were adjacent to land use areas that had a potential for supporting cattle (*e.g.,* pasture) were identified. If the stream segment flowed through the land-use area, it was assumed that fencing was needed on both sides of the stream. If a stream segment flowed adjacent to the land-use area, it was assumed that fencing was required on only one side of the stream. Due to limitations with the available GIS hydrology stream layers only perennial streams were included in this process. Not every land-use area identified as pasture has livestock on it at any given point in time. However, it is assumed that all pasture areas have the potential for livestock access. A map of potential streamside fencing required for streams in the watersheds is shown in Figure 5.1.

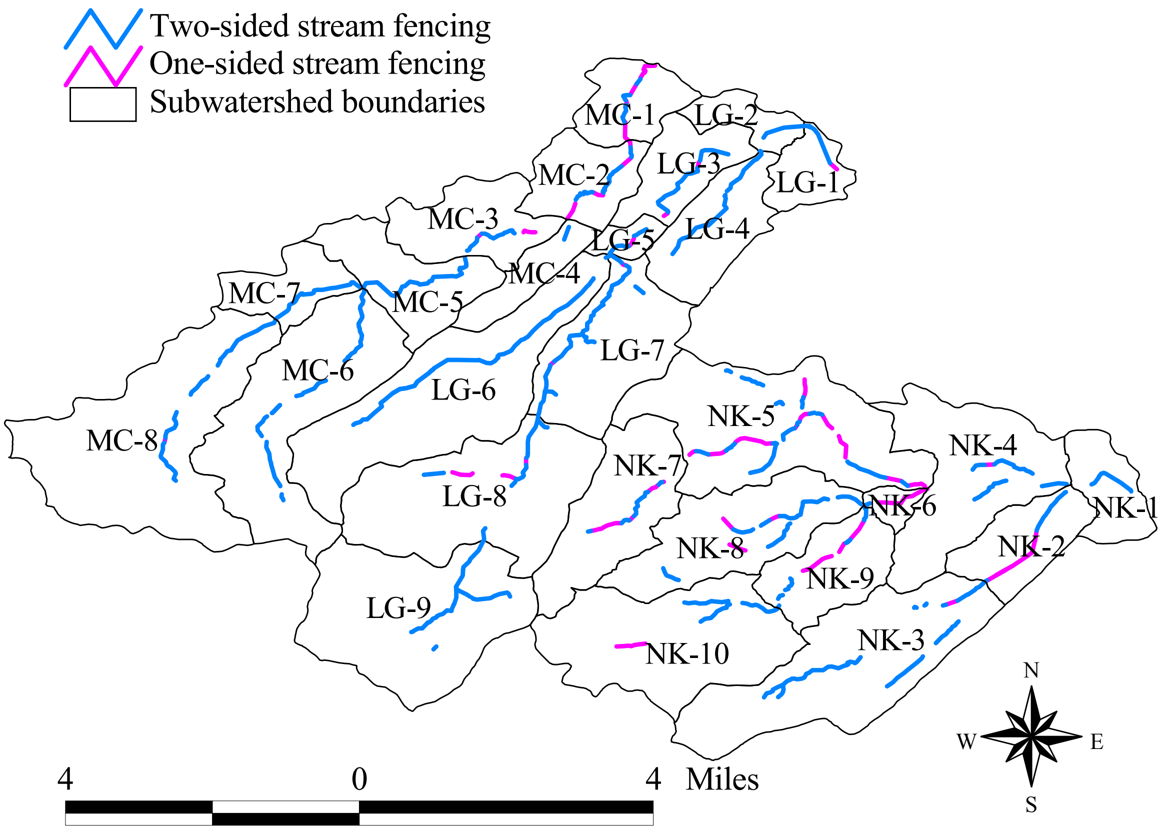

Figure 5.1 Potential stream exclusion fencing by subwatershed along Mossy Creek, Long Glade Run and Naked Creek (MC-Mossy Creek, LG-Long Glade Run, NK-Naked Creek)

The VADCR Agricultural BMP Database was utilized to determine typical characteristics (*e.g.,* streamside fencing length per practice) of full livestock exclusion systems so that the number of different systems needed could be accurately estimated . The database was queried for information on Grazing Land Protection Systems (SL-6) and Stream Protection Systems (WP-2 and WP-2T) installed in Rockingham and Augusta Counties. The SL-6 system includes streamside fencing, cross fencing, an alternative watering system, and a 35-ft buffer from the stream. It was estimated that 15% of livestock exclusion would be accomplished through the installation of SL-6 systems. In January 2009, a new livestock exclusion practice was introduced as part of the VA Agricultural Cost Share Program. This new practice, Livestock Exclusion with Riparian Buffers (LE-

1T) offers 85% cost share for management components included in the SL-6 practice, and is only available in targeted TMDL watersheds with implementation plans. Consequently, this practice was substituted for the SL-6 practice in this implementation plan. The WP-2 and WP-2T systems include streamside fencing, hardened crossings, and a 35-ft buffer from the stream. The WP-2T practice is only available in TMDL targeted implementation areas such as Mossy Creek, Long Glade Run and Naked Creek. This practice includes an up-front cost share payment of 50 cents per linear foot of fence installed to assist in covering anticipated fencing maintenance costs. In cases where a watering system already exists, a WP-2T system is a more appropriate choice. Despite the additional payment for maintenance costs, member of the agricultural working group explained that this practice is seldom used because it does not provide cost share for the installation of a well, this was reflected in the number of WP-2 systems noted in the Ag BMP Database. Consequently, it was estimated that only 5% of fencing would be accomplished using the WP-2T practice. In addition to considering LE-1T and WP-2T systems for implementation, fencing with a reduced setback (LE-2T) and fencing through the Conservation Reserve Enhancement Program (CREP) were included in implementation scenarios. Based on input from NRCS and SWCD staff, it was determined that landowners who are willing to install fencing with a 35-ft setback typically decide to use CREP. Consequently, it was estimated that 57% of fencing would be installed through CREP. During the agricultural working group meetings, it was concluded that it is unlikely that all farmers in the watersheds would be willing to install fencing with a 35-ft setback. In January 2009, a new livestock exclusion practice with a reduced setback requirement was introduced through the VA Agricultural Cost Share Program. The Livestock Exclusion with Reduced Setback Practice (LE-2T) is only available in targeted TMDL areas with implementation plans. This practice requires a 10 foot setback for stream fencing, and is more flexible in fencing materials allowed. Cost share is provided for stream fencing and cross fencing, and off stream waterers at a rate of 50%. It was estimated the 15% of livestock exclusion would be accomplished through the LE-2T practice. In addition, the Conservation Reserve Program (CRP) was noted by NRCS staff as another alternative for landowners who do not want to install a 35-ft buffer. In order to receive financial assistance, this program only requires a 20-ft buffer. Consequently, it was estimated that 8% of fencing would be installed through CRP.

Based on queries of the VADCR Agricultural BMP Database, 15 SL-6 systems and 1 WP-2 system have been installed in the Mossy Creek watershed for a total of 37,889 linear feet of fencing. In the Long Glade Run watershed, 9 SL-6 systems and 2 WP-2 systems have been installed, totaling 32,316 linear feet. In the Naked Creek watershed, 24 SL-6 systems and 5 WP-2 systems have been installed for a total of 91,099 linear feet of fencing. The average streamside fencing length for an SL-6/LE-1T system was initially estimated at 1,467 linear feet. This figure was increased to 3,000 linear feet based on parcel data indicating that a 3,000 foot system better matched the average length of stream on a typical farm in the watersheds. CREP and CRP systems were also estimated at 3,000 linear feet/system. The average WP-2 system was 1,028 linear feet, and the average length of LE-2T systems was estimated at 3,000 feet. This estimate was developed based on data provided by the Shenandoah RC&D through a pilot alternative fencing program and from input from the working groups.

To establish the total number of livestock exclusion systems necessary to achieve full implementation, systems were calculated by dividing the potential streamside fencing needed by the average streamside fencing length per system.

The breakdown of the number of LE-1T, WP-2, LE-2T, and CREP/CRP exclusion systems is based on historical use of these practices in Augusta and Rockingham Counties and input from the agricultural working group. Fencing that was already in place in each of the watersheds was subtracted from the total fencing needs (Table 5.2). Tables 5.3-5 show the livestock exclusion requirements for Mossy Creek, Long Glade Run and Naked Creek, respectively. It was estimated that 7.5% of all fencing installed would need to be replaced during the length of the project.

Table 5.2 Total livestock exclusion fencing for Mossy Creek, Long Glade Run and Naked Creek

Watershed	Sub-watershed	Total fencing needed (ft)	Fencing since TMDL (ft)	Fencing still needed (ft)
Mossy Creek	1	9,780	0	9,780
	2	2,261	0	2,261
	3	1,331	2,899	0
	4	1,090	0	1,090
	5	5,148	0	5,162
	6	29,491	0	29,491
	7	17,268	0	17,268
	8	12,720	0	12,720
	Total	**79,088**	**2,899**	**77,757**
Long Glade Run	1	12,474	0	12,474
	2	5,179	0	5,179
	3	14,442	0	14,442
	4	18,553	0	18,553
	5	5,377	0	5,377
	6	28,392	9,544	18,848
	7	24,754	2,125	22,629
	8	15,994	0	15,994
	9	8,369	0	8,369
	Total	**133,534**	**11,669**	**121,865**
Naked Creek	1	6,207	0	6,207
	2	9,583	0	9,583
	3	29,580	0	29,580
	4	6,519	2,767	3,752
	5	24,236	4,881	19,355
	6	3,829	0	3,829
	7	0	14,378*	0
	8	15,105	1,000	14,105
	9	13,435	0	13,435
	10	1,843	0	1,843
	Total	**110,337**	**23,026**	**101,689**

*Fencing total may include fencing on intermittent streams, causing it to exceed fencing still needed which includes only perennial streams

Table 5.3 Estimate of full streamside exclusion fencing systems needed in Mossy Creek subwatersheds

Sub-watershed	CREP fencing		CRP fencing		LE-1T fencing		WP-2T fencing		LE-2T fencing	
	Linear feet	Systems	Linear feet	Systems	Linear feet	Systems	Linear feet	Systems	Linear feet	Systems
1	5,575	2	782	0	1,467	1	489	1	1,467	1
2	1,288	0	181	0	339	0	113	0	339	0
3	0	0	0	0	0	0	0	0	0	0
4	621	0	87	0	164	0	55	0	164	0
5	2,934	1	412	0	774	0	257	0	772	0
6	16,810	6	2,359	1	4,424	1	1,475	1	4,424	1
7	9,843	3	1,381	1	2,590	1	863	1	2,590	1
8	7,250	3	1,018	0	1,908	1	636	1	1,908	1
Totals	**44,321**	**15**	**6,221**	**2**	**11,663**	**4**	**3,888**	**4**	**11,663**	**4**

Table 5.4 Estimate of full streamside exclusion fencing systems needed in Long Glade Run subwatersheds

Sub-watershed	CREP fencing		CRP fencing		LE-1T fencing		WP-2T fencing		LE-2T fencing	
	Linear feet	Systems	Linear feet	Systems	Linear feet	Systems	Linear feet	Systems	Linear feet	Systems
1	7,110	2	998	0	1,871	1	624	1	1,871	1
2	2,952	1	414	0	777	0	259	0	777	0
3	8,232	3	1,155	0	2,166	1	722	1	2,166	1
4	10,575	4	1,484	1	2,783	1	928	1	2,783	1
5	3,065	1	430	0	807	0	269	0	807	0
6	10,743	4	1,508	1	2,827	1	942	1	2,827	1
7	12,899	4	1,810	1	3,394	1	1,131	1	3,394	1
8	9,117	3	1,280	0	2,399	1	800	1	2,399	1
9	4,771	2	670	0	1,255	0	418	0	1,255	0
Totals	**69,463**	**23**	**9,749**	**3**	**18,280**	**6**	**6,093**	**6**	**21,536**	**6**

Table 5.5 Estimate of full streamside exclusion fencing systems needed in Naked Creek subwatersheds

Sub-watershed	CREP fencing		CRP fencing		LE-1T fencing		WP-2T fencing		LE-2T fencing	
	Linear feet	Systems	Linear feet	Systems	Linear feet	Systems	Linear feet	Systems	Linear feet	Systems
1	3,538	1	497	0	931	0	310	0	931	0
2	5,462	2	767	0	1,437	1	479	1	1,437	1
3	16,861	5	2,366	1	4,437	2	1,479	1	4,437	1
4	2,139	1	300	0	563	0	188	0	563	0
5	11,032	3	1,548	1	2,903	1	968	1	2,903	1
6	2,183	1	306	0	574	0	191	0	574	0
7	0	0	0	0	0	0	0	0	0	0
8	8,040	3	1,128	1	2,116	1	705	1	2,116	1
9	7,658	3	1,075	0	2,015	1	672	1	2,015	1
10	1,051	0	147	0	276	0	92	0	279	0
Totals	**57,963**	**19**	**8,135**	**3**	**15,253**	**6**	**5,084**	**5**	**15,253**	**5**

Land Based Agricultural BMPs

In order to meet the bacteria and sediment reductions outlined in the TMDLs, best management practices to treat land-based sources of the pollutants must also be included in implementation efforts. One practice that is expected to have a substantial impact on water quality is improved pasture management. It is anticipated that this improved management will take the form of both rotational grazing systems and rotational loafing lot systems. Vegetated buffers were also included in the implementation strategy to treat runoff from pasture and cropland. These buffers will act as filters, trapping bacteria and sediment before it runs in to the stream. When considering the effectiveness of a vegetated buffer in trapping pollutants, it is important to consider the area that will be draining to the buffer. For modeling purposes, it was assumed that a typical buffer would be capable of receiving and treating runoff from an area four times its width. For example, a buffer that was 35 feet wide and 1,000 feet long would treat runoff from an area that was 140 feet wide and 1,000 feet long. Once you move beyond four times the buffer width, it was assumed that the runoff would be in the form of channelized flow rather than the sheet flow that a buffer can trap. Consequently, it was necessary to consider both riparian buffers and upland buffers in order to treat runoff from pasture. A combination of grassed filter strips and wooded buffer strips could be used in upland areas (50:50). Based on input from the working groups, it is unlikely that a large number of farmers would be interested in installing upland buffers, so the use of this best management practices was minimized in implementation scenarios.

5.2.2 Residential Control Measures

Correcting Failing Septic Systems and Straight Pipes

All straight pipes and failing septic systems must be identified and corrected during implementation based on preexisting legal requirements. Table 5.5 shows the estimated number of failing septic systems and straight pipes for each subwatershed in the Mossy Creek, Long Glade Run and Naked Creek watersheds.

Based on input from the Augusta County Health Department and the residential working group, it was estimated that 50% of failing septic systems could be corrected with a repair, the remaining 50% would need to be replaced. In Mossy Creek, it was estimated that approximately 6% of systems that needed to be replaced would have to be alternative waste treatment systems while the remainder of the replacements would be with conventional septic systems. In Long Glade Run and Naked Creek, the need for alternative systems estimated to be greater (19% of replacements) due to the geology and soils in the watershed (Table 5.6).

Table 5.6 Estimated residential waste treatment systems in the Mossy Creek, Long Glade Run and Naked Creek subwatersheds.

	Mossy Creek		**Long Glade Run**		**Naked Creek**	
Subwater-shed	Replace with septic system	Replace with alternative system	Replace with septic system	Replace with alternative system	Replace with septic system	Replace with alternative system
1	5	0	5	1	3	1
2	1	0	2	1	4	1
3	4	0	2	1	11	3
4	2	0	2	0	10	2
5	1	0	0	0	3	0
6	7	1	5	1	3	1
7	7	1	4	1	2	0
8	7	0	2	1	3	1
9	------	------	7	1	3	1
10	------	------	------	------	6	1
Totals	34	2	29	7	49*	11

*Total is higher than column sum due to rounding.

Land-Based Residential BMPs

The development of a pet waste education program will help to reduce the amount of bacteria from pet waste entering the streams. The residential working group agreed that distributing information reminding pet owners to pick up after their pets would be effective. The group could not identify any areas where pet waste stations could be installed in the watersheds where people typically walk their dogs such as public parks. Pet waste digesters were included as a management strategy that homeowners could install in their yards. These digesters allow homeowners to safely compost their pet's waste, which can then be used as a fertilizer for flower beds.

In order to address sediment coming from residential areas, rain gardens could be installed to catch and treat runoff from yards and driveways. A typical rain garden should be designed to receive runoff from approximately 1 acre of land. These gardens can serve as attractive landscape features while also improving water quality. Residential BMPs are shown in Table 5.7.

Table 5.7 Land-based BMPs for Mossy Creek, Long Glade Run, and Naked Creek

Land use	BMP	Units	Mossy Creek	Long Glade	Naked Creek
Pasture	Riparian buffer: CREP	system	15	23	19
	Riparian buffer: CRP	system	2	3	3
	Livestock excl.w/buffer: LE-1T	system	4	6	5
	Stream protection: WP-2T	system	4	6	5
	Livestock excl.(red. setb.):LE-2T	system	4	6	5
	Loafing lot management: WP-4B	system	2	1	1
	Improved pasture management	acres	5802	7246	9,444
	Reforestation of erodible pasture: FR-1	acres	508	725	1,180
Pasture & Cropland (applied manure)	Poultry litter storage: WP-4	system	2	2	2
	Dairy manure storage: WP-4	system	1	2	2
	Beef manure storage: WP-4	system	3	3	0
	Sinkhole protection: WQ-11	system	10	10	10
Cropland	Conservation tillage	acres	1376	------	------
	Field border: FR-1	acres	264	160	------
	Woodland buffer filter area: FR-3	acres	5	14	------
	Grass filter strip: WQ-1	acres	5	14	------
	Continuous no-till: SL-15A	acres	206	------	------
	Sod waterway: WP-3	acres	3	------	------
	Cover crop: SL-8B	acres	399	------	------
	Contour farming	acres	222	------	------
	Permanent veg. cover: SL-1	acres	124	------	------
	Enhanced riparian buffer: CREP	acres	27	------	------
Residential	Pet waste program	program	1	1	1
	Pet waste digesters	digester	221	209	150

	Rain gardens	drainage-acres	19	-------	10
	Septic system repairs: RB-3	repairs	36	35	60
	Septic system replacement: RB-4	system	34	29	49
	Alternative waste treatment: RB-5	system	2	7	11

5.3 Technical Assistance and Education

In order to get landowners involved in implementation, it will be necessary to initiate education and outreach strategies and provide technical assistance with the design and installation of various best management practices. There must be a proactive approach to contact farmers and residents to articulate exactly what the TMDL means to them and what practices will help meet the goal of improved water quality. The working groups recommended several education/outreach techniques, which will be utilized during implementation. Outreach at county fairs has been successful in other watersheds in the past. There are also opportunities for joint events with the Virginia Cooperative Extension Service. It was recommended that Headwaters SWCD work with Cooperative Extension to hold a series of workshops and demonstrations on the benefits of conservation tillage and continuous no-till for farmers cropping in the watersheds. Presentations at local Ruritan and Rotary clubs were mentioned as a good way to reach farmers as well. Landowners in the watersheds noted that it will be important to conduct a mailing promoting programs to assist homeowners with septic system maintenance and the correction of straight pipes. It was suggested that this mailing clearly state that homeowners who come forward for assistance will not be pursued legally by the Health Department if they have a straight pipe. The following general tasks associated with agricultural and residential programs were identified:

Agricultural Programs

1. Make contact with landowners in the watershed to make them aware of implementation goals, cost-share assistance, and voluntary options that are beneficial.
2. Provide technical assistance for agricultural programs (*e.g.,* survey, design, layout, and approval of installation).
3. Develop educational materials & programs.

4. Organize educational programs (*e.g.,* County Fair, presentations at joint VCE events or club events).
5. Distribute educational materials (*e.g.,* informational articles in FSA or Farm Bureau newsletters, local media).
6. Handle and track cost-share.
7. Assess and track progress toward BMP implementation goals.
8. Coordinate use of existing agricultural programs and suggest modifications where necessary.

Residential Programs

1. Identify straight-pipes and failing septic systems (*e.g.*, contact landowners in older homes, septic pump-out program).
2. Handle and track cost-share.
3. Develop educational materials & programs.
4. Organize educational programs (*e.g.*, demonstration septic pump-outs, nutrient management, pet waste control).
5. Distribute educational materials (*e.g.*, informational pamphlets on TMDL IP and on-site sewage disposal systems).
6. Assess progress toward implementation goals.

The staffing level needed to implement the agricultural and residential components of the plan were estimated based on discussions with stakeholders and the staffing levels used in similar projects. Staffing needs were quantified using full time equivalents (FTE), with one FTE being equal to one full-time staff member. It was determined that one FTE would be needed for each watershed to provide the technical assistance needed for agricultural and residential implementation.

5.4 Cost Analysis

5.4.1 Agricultural BMPs

The costs of agricultural best management practices included in the implementation plan were estimated based on data for Augusta and Rockingham Counties from the VADCR Agricultural BMP Database. When sufficient data was available, the search for best management practices and their associated costs was limited to 2000 through 2008 so that estimates were as current as possible. Cost estimates were further refined following discussions with stakeholders.

The total cost of livestock exclusion systems includes not only the costs associated with fence installation, repair, and maintenance, but also the cost of developing alternative water sources for LE-1T, LE-2T, CREP and CRP practices and installing hardened crossings for WP-2T practices. The cost of fence maintenance was identified as a deterrent to participation. Financial assistance possibilities for maintaining fences include an annual 25% tax credit for fence maintenance an upfront incentive payment on $0.50 per linear foot to maintain stream fencing as part of the WP-2T practice. Based on input from the working group, it was determined that the average cost of fence maintenance is significantly higher. In developing the cost estimates for fence maintenance shown in Table 5.9, a figure of $3.50/linear foot of fence was used. It was estimated that approximately 10% of fencing would need to be replaced every 10 years. This maintenance cost was not assigned to alternative fencing due to the far lower cost of replacing this type of fencing and the fact that it can be taken down prior to a storm that may produce a flooding event.

Table 5.8 Agricultural control measure costs (MC-Mossy Creek, LG-Long Glade Run, NK-Naked Creek) Note: Practice units are listed in Table 5.6

Land use	BMP	Cost/ Unit	Total Cost MC	Total Cost LG	Total Cost NK
Pasture	Riparian buffer: CREP	$25,460	$376,150	$589,526	$491,925
	Riparian buffer: CRP	$23,500	$48,728	$71,124	$63,725
	Riparian buffer: LE-1T	$23,500	$91,364	$143,192	$119,485
	Stream fencing: LE-2T	$14,960	$58,356	$91,460	$76,318
	Stream protection: WP-2T	$9,700	$18,912	$57,489	$47,971
	Fence replacement over 10	$3.50	$23,133	$36,255	$30,253
	Loafing lot mgmt: WP-4B	$40,935	$80,790	$40,935	$40,935
	Improved pasture mgmnt.	$107	$620,814	$775,322	$1,010,508
	Reforestation of erodible pasture	$154	$78,268	$111,712	$181,720
Pasture & Cropland (applied manure)	Poultry litter storage: WP-4	$24,500	$49,000	$49,000	$49,000
	Liquid manure storage: WP-4	$63,400	$63,400	$126,800	$126,800
	Dry manure storage: WP-4	$36,300	$108,900	$108,900	$0
	Sinkhole protection: WQ-11	$2,500	$25,000	$25,000	$25,000
Cropland	Conservation tillage	$100	$40,000	------	------
	Field border: FR-1	$154	$40,733	$24,653	------
	Woodland buffer filter area: FR-3	$450	$2,171	$6,084	------
	Grass filter strip: WQ-1	$50	$241	$676	------
	Continuous no-till: SL-15A	$100	$20,600	------	------
	Sod waterway: WP-3	$2,060	$6,180	------	------
	Cover crop: SL-8B	$40	$62,349	------	------
	Contour farming	$40	$3,853	------	------
	Permanent vegetative cover	$145	$17,956	------	------
	Enhanced riparian buffer: CREP	$450	$12,059	------	------
		TOTALS	**$1,866,726**	**$2,585,738**	**$2,263,640**

5.4.2 Residential Control Measures

Following recommendations from the RWG and the Augusta County Health Department, it was assumed that approximately 3% of failing septic systems and straight pipe would require new alternative treatment systems in the Mossy Creek watershed and approximately 7% in the Long Glade Run watershed. It was estimated that 50% of failing septic systems could be corrected with a repair, while 47% and 40% would need to be replaced with a conventional septic system in Mossy Creek and Long Glade Run, respectively.

Table 5.9 Residential best management practice costs (MC-Mossy Creek, LG-Long Glade Run, NK-Naked Creek) Note: Practice units are listed in Table 5.6

BMP	Cost/Unit	Total Cost MC	Total Cost LG	Total Cost NK
Pet waste program	$3,750	$3,750		
Pet waste digesters	$60	$13,260	$12,540	$9,000
Rain gardens	$10,000	$190,000	------	$100,000
Septic system repairs: RB-3	$3,000	$108,000	$105,000	$180,000
Septic system replacement: RB-4	$6,500	$221,000	$188,500	$318,500
Alternative waste treatment: RB-5	$20,000	$40,000	$140,000	$220,000
TOTALS		**$573,510**	**$447,290**	**$828,750**

5.4.3 Technical Assistance

It was determined that it would require $50,000 to support the salary, benefits, travel, training, and incidentals for education of one technical FTE. With quantification analysis yielding a need for three full-time FTEs per year to cover the three watersheds, the total potential cost to provide technical assistance during implementation is expected to be approximately $150,000 per year for 10 years.

5.4.4 Total Estimated Costs

The total estimated costs for the implementation of best management practices in the Mossy Creek, Long Glade Run and Naked Creek watersheds is shown in Table 5.12.

Table 5.10 Total estimated costs to meet the Mossy Creek, Long Glade Run and Naked Creek TMDLs (bacteria and sediment)

Watershed	Cost of Agricultural BMPs	Cost of Residential BMPs	Cost of Technical Assistance
Mossy Creek	$1,866,726	$573,510	$500,000
Long Glade Run	$2,585,738	$447,290	$500,000
Naked Creek	$2,263,640	$828,750	$500,000
TOTALS	**$6,716,104**	**$1,849,550**	**$1,500,000**

5.5 Benefit Analysis

The primary benefit of implementing this plan will be cleaner water in Mossy Creek, Long Glade Run and Naked Creek. Specifically, *E. coli* contamination in the creeks will be reduced to meet water quality standards, and sediment loading into Mossy Creek will be reduced to support a healthy aquatic community. It is hard to gage the impact that reducing *E. coli* contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, because of the reductions required, the incidence of infection from *E. coli* sources through contact with surface waters should be reduced considerably.

An important objective of the implementation plan is to foster continued economic vitality. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians and a healthy economic base provides the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document will provide economic benefits to the community, as well as the expected environmental benefits. Specifically, alternative (clean) water sources, exclusion of cattle from streams, improved pasture management, and private sewage system maintenance will each provide economic benefits to land owners. Additionally, money spent by landowners and state agencies in the process of implementing this plan will stimulate the local economy.

Agricultural Practices

A clean water source has been shown to improve weight gain and milk production in cattle. Fresh clean water is the primary nutrient for livestock with healthy cattle consuming, on a daily basis, close to 10% of their body weight during winter and 15% of their body weight in summer. Many livestock illnesses can be spread through contaminated water supplies. For instance, coccidia can be delivered through feed, water and haircoat contamination with manure (VCE, 2000). In addition, horses drinking from marshy areas or areas where wildlife or cattle carrying Leptospirosis have access tend to have an increased incidence of moonblindness associated with Leptospirosis infections (VCE, 1998b). A clean water source can prevent illnesses that reduce production and incur the added expense of avoidable veterinary bills.

In addition to reducing the likelihood of animals contracting waterborne illnesses by providing a clean water supply, streamside fencing excludes livestock from wet, swampy environments as are often found next to streams where cattle have regular access. Keeping cattle in clean, dry areas has been shown to reduce the occurrence of mastitis and foot rot. The VCE (1998a) reports that mastitis costs producers $100 per cow in reduced quantity and quality of milk produced. On a larger scale, mastitis costs the U.S. dairy industry about $1.7 billion to 2 billion annually or 11% of total U.S. milk production. While the spread of mastitis through a dairy herd can be reduced through proper sanitation of milking equipment, mastitis-causing bacteria can be harbored and spread in the environment where cattle have access to wet and dirty areas. Installation of streamside fencing and well managed loafing areas will reduce the amount of time that cattle have access to these areas.

Taking the opportunity to implement an improved pasture management system in conjunction with installing clean water supplies will also provide economic benefits for the producer. Improved pasture management can allow a producer to feed less hay in winter months, increase stocking rates by 30 to 40% and, consequently, improve the profitability of the operation. With feed costs typically responsible for 70 to 80 % of the cost of growing or maintaining an animal, and pastures providing feed at a cost of 0.01 to

0.02 cents/lb of total digestible nutrients (TDN) compared to 0.04 to 0.06 cents/lb TDN for hay, increasing the amount of time that cattle are fed on pasture is clearly a financial benefit to producers (VCE, 1996). Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal. In addition to reducing costs to producers, intensive pasture management can boost profits by allowing higher stocking rates and increasing the amount of gain per acre. Another benefit is that cattle are closely confined allowing for quicker examination and handling. In general, many of the agricultural BMPs recommended in this document will provide both environmental benefits and economic benefits to the farmer.

Residential Practices

The residential programs will play an important role in improving water quality, since human waste can carry with it human viruses in addition to the bacterial and protozoan pathogens that all fecal matter can potentially carry. In terms of economic benefits to homeowners, an improved understanding of on-site sewage treatment systems, including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20 to 25 years if properly maintained. Proper maintenance includes: knowing the location of the system components and protecting them (*e.g.,* not driving or parking on top of them), not planting trees where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every 3 to 5 years. The cost of proper maintenance, as outlined here, is relatively inexpensive ($225) in comparison to repairing or replacing an entire system ($6,000 to $22,500).

In addition to the benefits to individual landowners, the economy of the local community will be stimulated through expenditures made during implementation, and the infusion of dollars from funding sources outside the impaired areas. Building contractors and material suppliers who deal with septic system pump-outs, private sewage system repair and installation, fencing, and other BMP components can expect to see an increase in business during implementation. Additionally, income from maintenance of these systems should continue long after implementation is complete. As will be discussed in greater detail in Chapter 8, a portion of the funding for implementation can be expected to come from state and federal sources. This portion of funding represents money that is new to the area and will stimulate the local economy. In general, implementation will provide not only environmental benefits to the community, but economic benefits as well, which, in turn, will allow for individual landowners to participate in implementation.

6. MEASURABLE GOALS AND MILESTONES FOR ATTAINING WATER QUALITY STANDARDS

Given the scope of work involved with implementing these TMDLs, full implementation and de-listing from the Virginia Section 305(b)/303(d) list could be expected within 10 years provided that full funding for technical assistance (3 FTEs) and BMP cost share were available. Described in this section are potential funding sources, the identification of milestones, a timeline for implementation, the targeting of best management practices, and the roles of stakeholders during the process.

6.1 Milestones Identification

The end goals of implementation are restored water quality of the impaired waters and subsequent de-listing of the waters from the Commonwealth of Virginia's Section 305(b)/303(d) list within 10 years. Progress toward end goals will be assessed during implementation through tracking of best management practices through the Virginia Agricultural Cost-Share Program and continued water quality monitoring.

Expected progress in implementation is established with two types of milestones: *implementation milestones* and *water quality milestones*. Implementation milestones establish the amount of control measures installed within certain timeframes, while water quality milestones establish the corresponding improvements in water quality that can be expected as the implementation milestones are met. The milestones described here are intended to achieve full implementation within 10 years.

Following the idea of a staged implementation approach, resources and finances will be concentrated on the most cost-efficient control measures first. For instance, the bacteria source tracking results for Naked Creek indicated that livestock are a significant source of fecal pollution in the stream. Concentrating on implementing livestock exclusion fencing within the first year may provide the highest return on water quality improvement with less cost to landowners (Tables 6.1-3). It is anticipated that the most cost effective practices with be implementing in the watersheds during the first 5 years of the project. This will be referred to as Stage I of implementation. Following Stage I implementation, a steering committee should evaluate water quality improvements and determine how to proceed to complete implementation (Stage II). The timeline presented here proposes completing Stage II in 10 years. The final milestone would be de-listing of the impaired segments from the Section 303(d) list, which is anticipated by 2019.

Table 6.1 Staged implementation goals for Mossy Creek

Land use	BMP	Units	Stage I	Stage II
Pasture	Riparian buffer: CREP	system	12	3
	Riparian buffer: CRP	system	2	0
	Riparian buffer: LE-1T	system	3	1
	Stream fencing: LE-2T	system	3	1
	Stream protection: WP-2T	system	3	1
	Loafing lot management: WP-4B	system	1	1
	Improved pasture management	acres	2901	2901
	Reforestation of erodible pasture	acres	0	363
Pasture and Cropland (applied manure)	Poultry litter storage: WP-4	system	1	2
	Liquid manure storage: WP-4	system	0	2
	Dry manure storage: WP-4	system	1	1
	Sinkhole protection: WQ-11	system	0	10
Cropland	Conservation tillage	acres	260	140
	Field border: FR-1	acres	69	195
	Woodland buffer filter area: FR-3	acres	2	3
	Grass filter strip: WQ-1	acres	2	3
	Continuous no-till	acres	0	206
	Sod waterway	acres	1	2
	Cover crop: SL-8B	acres	277	53
	Permanent vegetative cover: SL-1	acres	55	69
	Contour farming	acres	96	0
	Enhanced riparian buffer: CREP	acres	13	14
Residential	Pet waste program	program	1	1
	Pet waste digesters	digester	0	221
	Rain gardens	drainage	0	19
	Septic system repairs: RB-3	repairs	26	10
	Septic system replacement: RB-4	system	24	10
	Alternative waste treatment: RB-5	system	1	1

Table 6.2 Staged implementation goals for Long Glade Run

Land use	BMP	Units	Stage I	Stage II
Pasture	Riparian buffer: CREP	system	18	5
	Riparian buffer:CRP	system	2	1
	Riparian buffer:LE-1T	system	5	1
	Stream exclusion: LE-2T	system	5	1
	Stream protection: WP-2T	system	5	1
	Loafing lot management: WP-4B	system	1	0
	Improved pasture management	acres	3623	3623
	Reforestation of erodible pasture	acres	0	725
Pasture and Cropland (applied manure)	Poultry litter storage: WP-4	system	1	1
	Liquid manure storage: WP-4	system	0	2
	Dry manure storage: WP-4	system	0	3
	Sinkhole protection: WQ-11	system	0	10
Cropland	Field border: FR-1	acres	0	160
	Woodland buffer filter area: FR-3	acres	7	6
	Grass filter strip: WQ-1	acres	7	6
Residential	Pet waste program	program	1	1
	Pet waste digesters	digester	0	209
	Septic system repairs: RB-3	repairs	25	10
	Septic system replacement: RB-4	system	20	9
	Alternative waste treatment: RB-5	system	5	2

Table 6.3 Staged implementation goals for Naked Creek

Land use	BMP	Units	Stage I	Stage II
Pasture	Riparian buffer: CREP	system	18	1
	Riparian buffer: CRP	system	3	0
	Riparian buffer: LE-1T	system	5	0
	Stream exclusion: LE-2T	system	5	0
	Stream protection: WP-2T	system	5	0
	Loafing lot management: WP-4B	system	0	1
	Improved pasture management	acres	4,722	4,722
	Reforestation of erodible pasture	acres	0	1,180
Pasture and Cropland (applied manure)	Poultry litter storage: WP-4	system	0	2
	Dairy manure storage: WP-4	system	0	2
	Beef manure storage/relocation of feedlot: WP-4/WP-8	system	0	0
	Sinkhole protection: WQ-11	system	0	10
Cropland	Conservation tillage	acres	0	0
	Field border: FR-1	acres	0	0
	Woodland buffer filter area: FR-3	acres	0	0
	Grass filter strip: WQ-1	acres	0	0
Residential	Pet waste program	program	1	1
	Pet waste digesters	digester	0	150
	Septic system repairs: RB-3	repairs	30	30
	Septic system replacement: RB-4	system	25	24
	Alternative waste treatment: RB-5	system	6	5

Table 6.4 Costs to implement **Stage I** (Years 1-5) for Mossy Creek, Long Glade Run and Naked Creek

Watershed	Agricultural BMPs	Residential BMPs	Technical Assistance	Total ($)
Mossy Creek	$999,582	$254,625	$250,000	$1,504,207
Long Glade Run	$1,238,786	$305,625	$250,000	$1,794,411
Naked Creek	$1,289,919	$373,125	$250,000	$1,903,544
TOTAL	**$3,528,287**	**$933,375**	**$750,000**	**$5,211,662**

Table 6.5 Costs to implement **Stage II** (Years 6-10) for Mossy Creek, Long Glade Run and Naked Creek

Watershed	Agricultural BMPs	Residential BMPs	Technical Assistance	Total ($)
Mossy Creek	$867,144	$318,885	$250,000	$1,436,029
Long Glade Run	$1,346,952	$141,665	$250,000	$1,738,617
Naked Creek	$973,721	$455,625	$250,000	$1,679,346
TOTAL	**$3,187,817**	**$916,175**	**$750,000**	**$4,853,992**

6.2 Timeline

A 10-year timeline was developed for implementation efforts in the Mossy Creek, Long Glade Run and Naked Creek watersheds (Figures 6.1-4, Tables 6.6-8). Figures 6.1, 6.3 and 6.4 show how the violation rate of the *E. coli* water quality standard is expected to change with BMP implementation over time. Figure 6.2 shows the expected decrease in sediment loading in Mossy Creek with BMP implementation over time. The timelines describe the needs for implementation in terms of completion of agricultural and residential control measures. Tables 6.6 through 6.8 show the percentage of each land use in the watersheds that will receive different BMPs each year. In some cases, a BMP will need to be applied to all of a particular land use (e.g., improved pasture management will need to be applied to 100% of pasture in Mossy Creek). In other cases, it will only be necessary to apply a specific BMP to a portion of a particular land use.

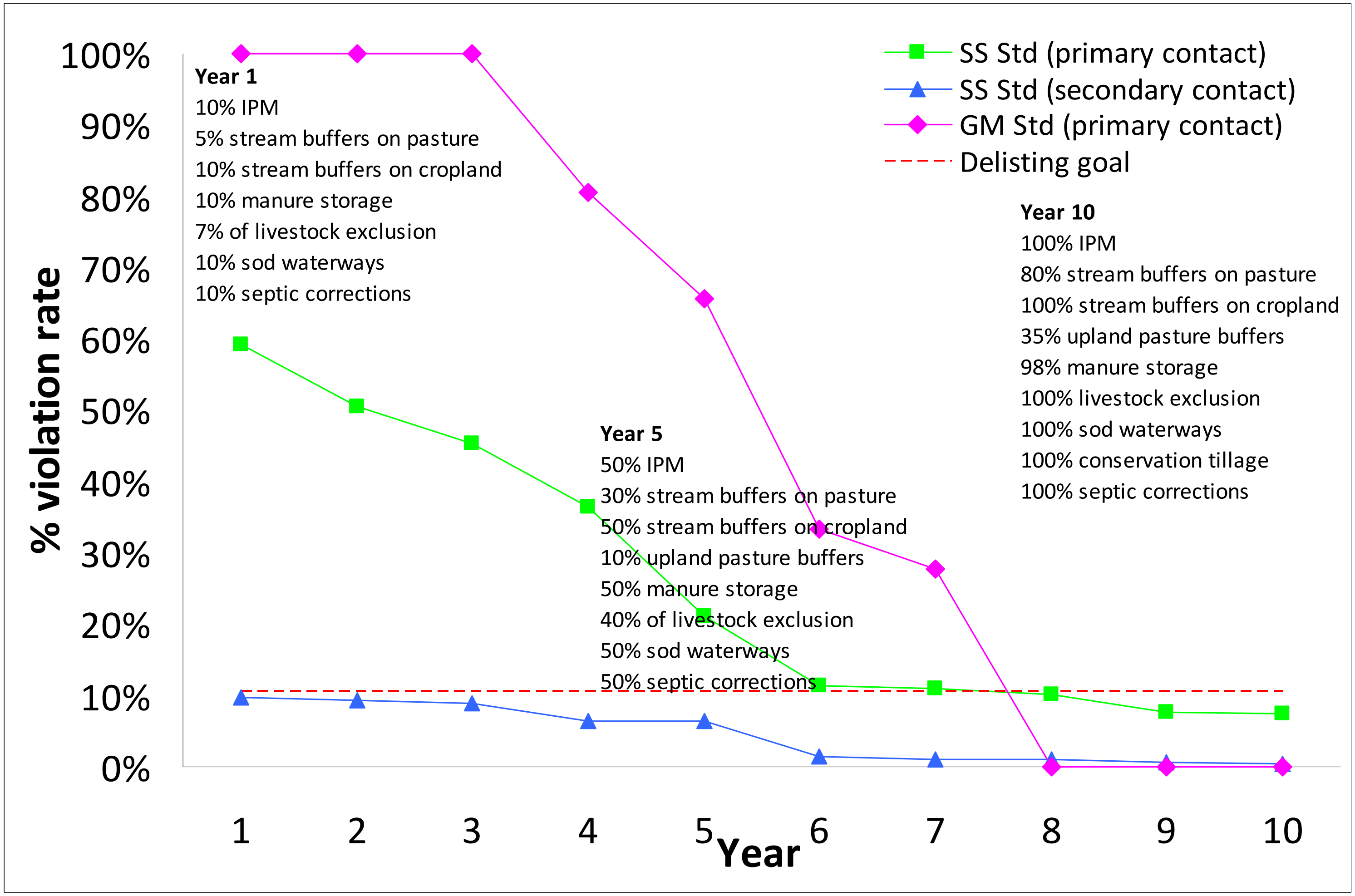

Figure 6.1 Bacteria water quality milestones in Mossy Creek following BMP implementation. Note: IPM=improved pasture management; SS std = single sample *E. coli* standard; GM std = geometric mean *E. coli* standard

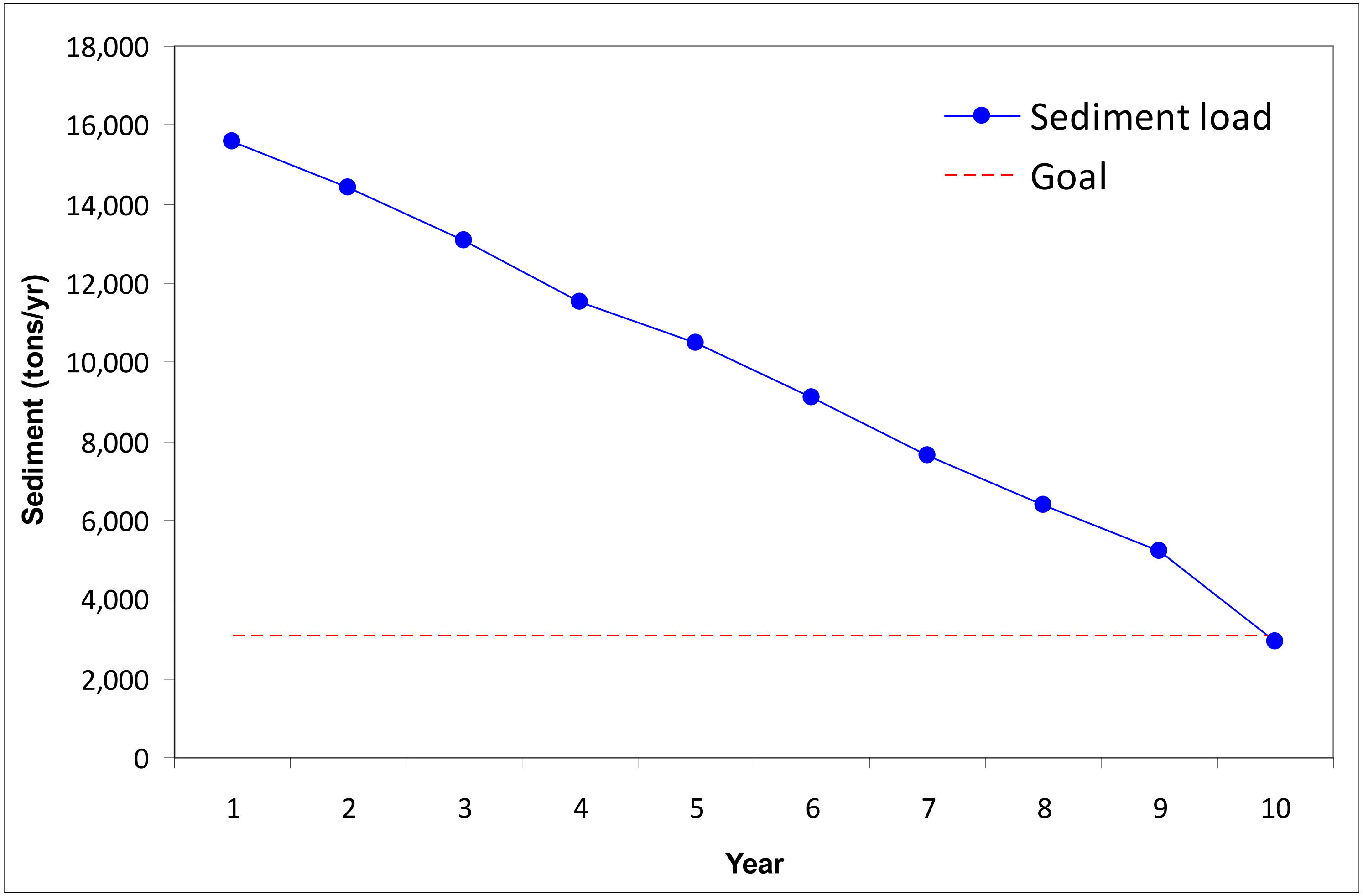

Figure 6.2 Sediment water quality milestones in Mossy Creek following BMP implementation. Note: BMP implementation rates are the same as those shown in Figure 6.1.

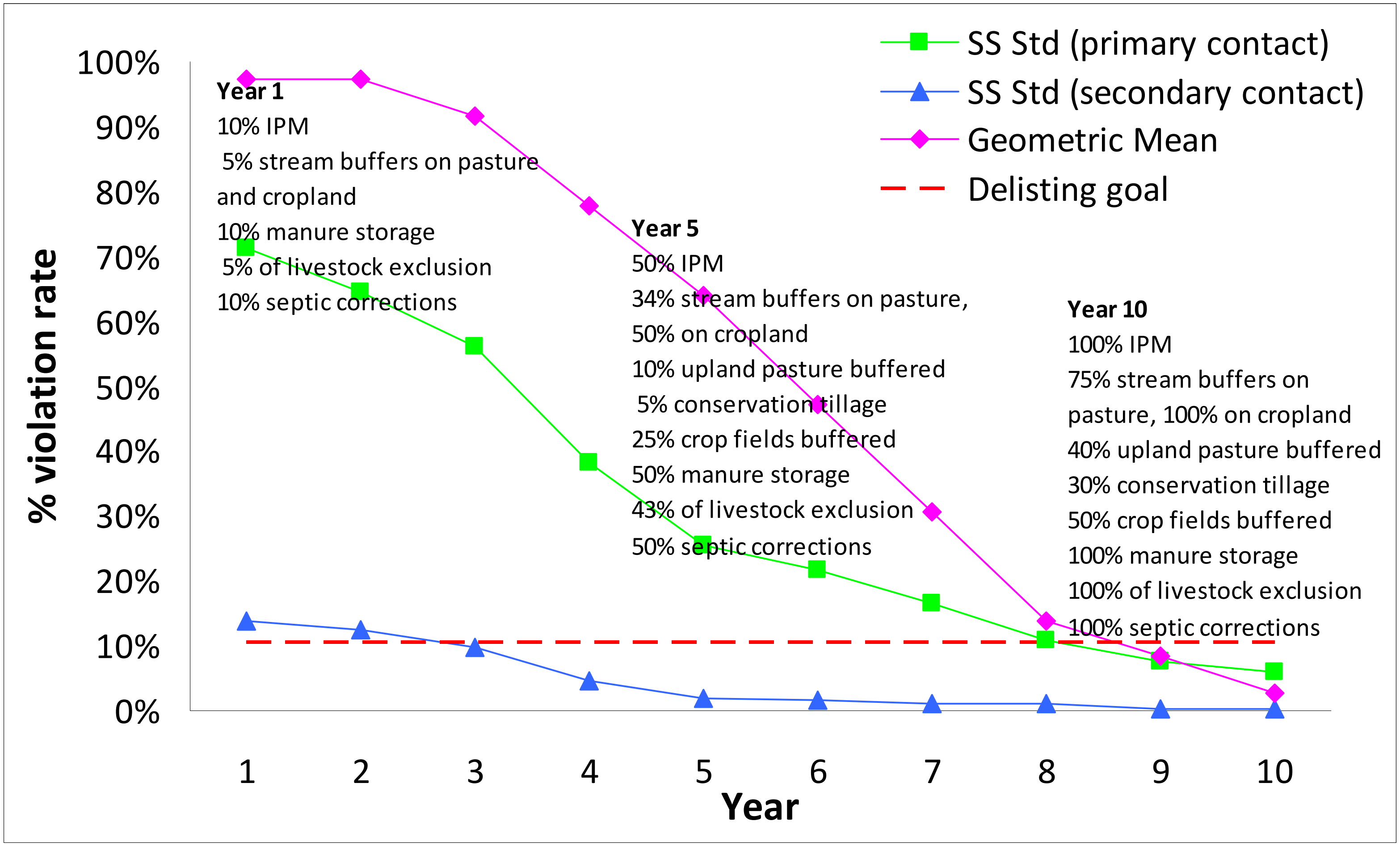

Figure 6.3 Bacteria water quality milestones in Long Glade Run following BMP implementation. Note: IPM=improved pasture management; SS std = single sample *E. coli* standard

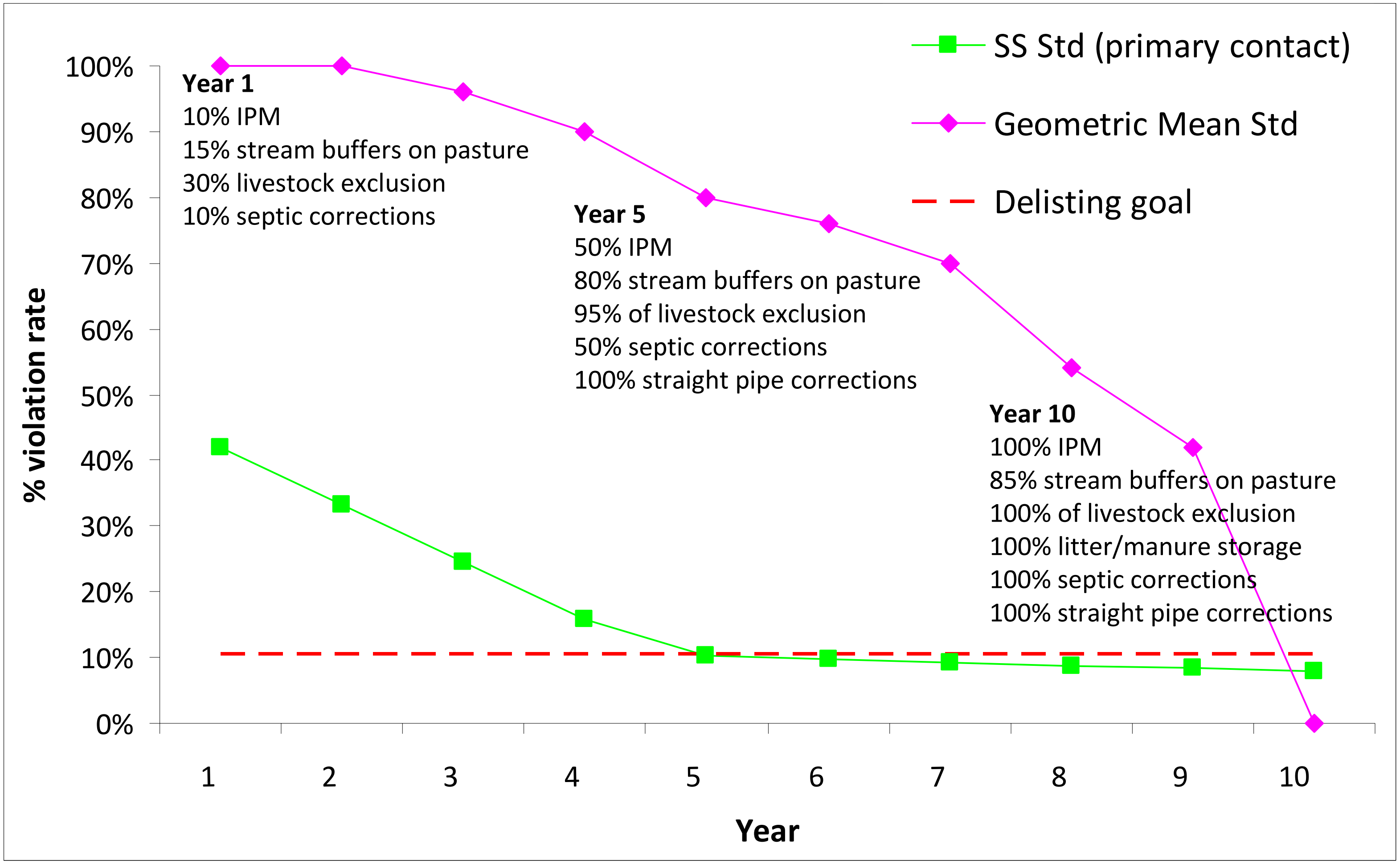

Figure 6.4 Bacteria water quality milestones in Naked Creek following BMP implementation. Note: IPM=improved pasture management; SS std = single sample fecal coliform standard

Table 6.6 Timeline for BMP implementation in Mossy Creek: % of land use receiving BMP by year

Land use	BMP	Year									
		1	2	3	4	5	6	7	8	9	10
Pasture	Total livestock exclusion	15%	30%	50%	70%	81%	87%	93%	96%	98%	100%
	Riparian buffer (35 ft)	10%	20%	35%	50%	60%	65%	70%	73%	75%	77%
	Riparian buffer (20 ft)	2%	4%	6%	8%	8%	8%	8%	8%	8%	8%
	Upland buffer (grass & forest)	0%	0%	0%	0%	0%	1%	2%	4%	6%	9%
	Loafing lot management	0%	0%	0%	50%	50%	100%	100%	100%	100%	100%
	Improved pasture management	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Applied manure	Poultry litter storage	0%	0%	0%	0%	50%	50%	50%	50%	50%	98%
	Manure storage	0%	0%	0%	0%	25%	25%	50%	50%	75%	98%
Cropland	Conservation tillage	10%	25%	40%	55%	65%	70%	80%	90%	100%	100%
	Field border	5%	10%	15%	20%	25%	40%	55%	70%	85%	96%
	Riparian buffer (35 ft)	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
	Riparian buffer (100 ft)	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
	Continuous no-till	0%	0%	0%	0%	0%	3%	6%	9%	12%	15%
	Sod waterway	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	Cover crop	0%	5%	10%	15%	20%	22%	24%	26%	28%	29%
	Contour farming	0%	0%	0%	7%	7%	7%	7%	7%	7%	7%
	Permanent vegetative cover	0%	0%	2%	2%	4%	4%	6%	6%	8%	8%
Residential	Pet waste program	0%	0%	5%	10%	15%	20%	25%	35%	45%	50%
	Pet waste digesters	0%	0%	0%	0%	0%	5%	10%	20%	30%	40%
	Rain gardens	0%	0%	0%	0%	0%	1%	2%	3%	4%	5%
	Septic system	10%	25%	40%	55%	70%	80%	90%	95%	100%	100%
% Violation of instantaneous stnd (primary)		59.1%	50.6%	45.4%	36.5%	21.2%	11.4%	11.0%	10.2%	7.7%	7.4%
% Violation of instantaneous stnd (secondary)		9.8%	9.3%	8.9%	6.4%	6.4%	1.4%	1.0%	1.0%	0.6%	0.5%
% Violation of geometric mean standard		100%	100%	100%	80.6%	65.7%	33.3%	27.8%	0%	0%	0%

Table 6.7 Timeline for BMP implementation in Long Glade Run: % of land use receiving BMP by year

Land use	**BMP**	**Year**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Pasture	Total livestock exclusion	15%	30%	50%	70%	81%	87%	93%	96%	98%	100%
	Riparian buffer (35 ft)	10%	20%	35%	50%	60%	65%	70%	73%	75%	77%
	Riparian buffer (20 ft)	2%	4%	6%	8%	8%	8%	8%	8%	8%	8%
	Upland buffer (grass & forest)	0%	0%	0%	0%	0%	0%	3%	6%	9%	10%
	Loafing lot management	0%	0%	0%	50%	50%	100%	100%	100%	100%	100%
	Improved pasture management	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Applied manure	Poultry litter storage	0%	0%	0%	0%	50%	50%	50%	50%	50%	100%
	Manure storage	0%	0%	0%	0%	0%	25%	50%	50%	75%	100%
Cropland	Field border	0%	0%	0%	0%	0%	10%	20%	30%	40%	50%
	Riparian buffer (35 ft)	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
	Riparian buffer (100 ft)	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
Residential	Pet waste program	0%	0%	5%	10%	15%	20%	25%	35%	45%	50%
	Pet waste digesters	0%	0%	0%	0%	0%	5%	10%	20%	30%	40%
	Septic system repair/replace	10%	25%	40%	55%	70%	80%	90%	95%	100%	100%
% Violation of instantaneous stnd (primary)		71.3%	64.6%	56.2%	38.1%	25.4%	21.6%	16.6%	11.0%	7.7%	5.9%
% Violation of instantaneous stnd (secondary)		13.9%	12.6%	9.8%	4.6%	1.8%	1.6%	1.0%	1.0%	0.3%	0.2%
% Violation of geometric mean standard		97.2%	97.2%	91.7%	77.8%	63.9%	47.2%	30.6%	13.9%	8.3%	2.8%

Table 6.8 Timeline for BMP implementation in Naked Creek: % of land use receiving BMP by year

Land use	BMP	Year									
		1	2	3	4	5	6	7	8	9	10
Pasture	Total livestock exclusion	30%	50%	65%	80%	95%	96%	97%	98%	99%	100%
	Riparian buffer (35 ft)	15%	30%	46%	60%	73%	73%	74%	75%	77%	77%
	Riparian buffer (20 ft)	0%	3%	3%	6%	7%	7%	8%	8%	8%	8%
	Upland buffer (grass & forest)	0%	0%	0%	0%	0%	10%	20%	30%	40%	50%
	Loafing lot management	0%	0%	0%	0%	0%	0%	0%	100%	100%	100%
	Improved pasture management	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Applied manure	Poultry litter storage	0%	0%	0%	0%	0%	50%	50%	50%	100%	100%
	Manure storage	0%	0%	0%	0%	0%	50%	50%	100%	100%	100%
Residential	Pet waste program	0%	0%	0%	0%	0%	30%	50%	60%	80%	97%
	Pet waste digesters	0%	0%	0%	0%	0%	23%	47%	67%	83%	100%
	Rain gardens	0%	0%	0%	0%	0%	20%	40%	60%	80%	100%
	Septic system repair/replace	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	Straight pipe removal	0%	33%	33%	66%	100%	100%	100%	100%	100%	100%
% Violation of instantaneous stnd (primary)		42.1%	33.3%	24.6%	15.7%	10.2%	9.7%	9.3%	8.8%	8.4%	8%
% Violation of instantaneous stnd (secondary)		13.9%	12.6%	9.8%	4.6%	1.8%	0%	0%	0%	0%	0%
% Violation of geometric mean standard		100%	100%	96.0%	90.0%	80.0%	76%	70%	54%	42%	0%

6.3 Prioritizing Implementation

Implicit in the process of a staged implementation is targeting of best management practices. Targeting ensures optimum utilization of limited technical and financial resources. The Mossy Creek watershed was divided into 8 subwatershed, Long Glade Run was divided into 9 subwatersheds, and Naked Creek was divided into 10 subwatersheds as shown earlier in Figure 3.1. Identification of critical areas for livestock fencing was accomplished through analysis of livestock population and the fencing needs for each subwatershed. The subwatersheds were ranked in descending order based on the ratio of animals per fence length and proximity to the headwaters of the creeks. If possible, effort should be made to prioritize resources for livestock exclusion in the following order of subwatersheds shown in Figure 6.5. For example, the Headwaters Soil and Water Conservation District could conduct mailings to producers with riparian land in subwatersheds identified as high priority for livestock exclusion. Since both the time of Conservation Technicians and money available for mailings at the Soil and Water Conservation District are limited, this type of strategy would allow for the greatest water quality benefit at the lowest cost. However, any interested parties should not be turned away if their farm is in a low ranking subwatershed. The success and importance of a prioritizing strategy depends in the level of interest in participating in cost share programs in the watersheds. For example, if interest was low and the Soil and Water Conservation District had only a few producers interested in livestock exclusion, they would probably rely less heavily on the subwatershed ranking provided in Figure 6.5.

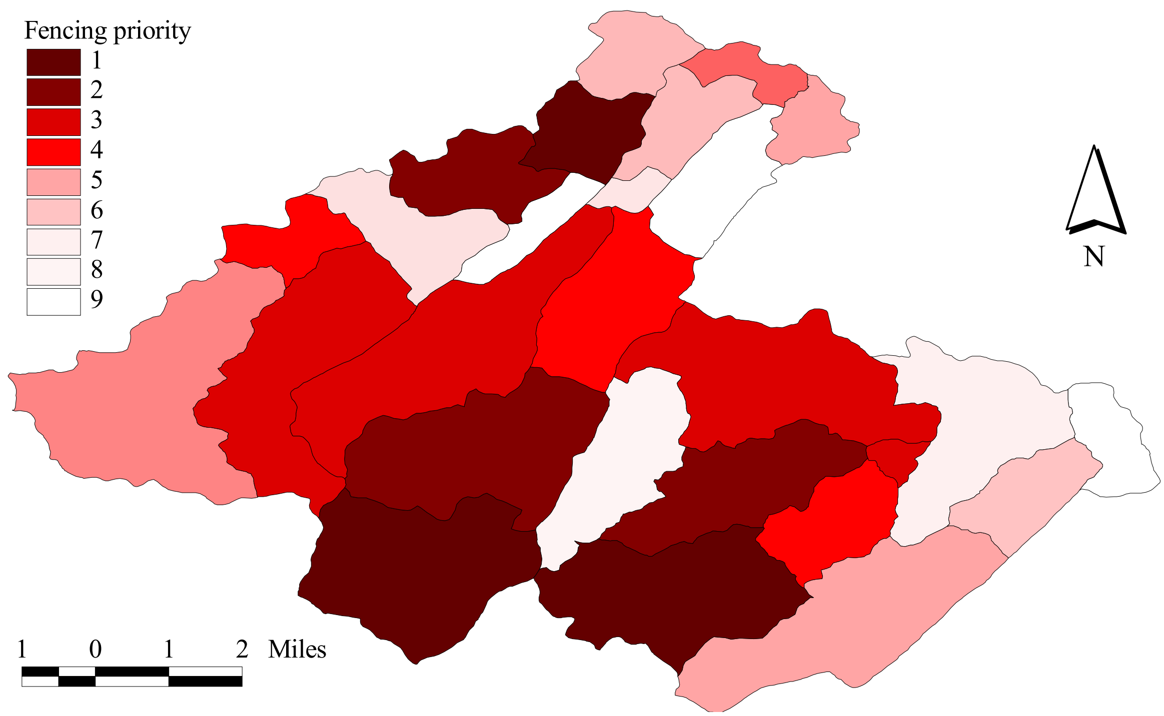

Figure 6.5 Potential livestock exclusion fencing prioritization for Mossy Creek, Long Glade Run and Naked Creek

In addition to considering factors such as the number of animals per length of fence, future land use patterns should also be considered in targeting conservation efforts, particularly in agricultural areas. Conservation easements are an excellent way to preserve open space, including farms, while also assuring continued land use taxation which should reduce estate tax burdens. From the perspective of conservation organizations providing financial assistance with agricultural BMPs, it makes sense to target these practices in areas that are likely to remain in agriculture, thereby increasing the likelihood that the practice will remain in place beyond the length of the contract that landowners must sign in order to receive cost share (these agreements typically cover a 10-year period over which the landowner is responsible for maintaining the practice). Figure 6.6 shows conservation easements that are currently in place in the watersheds. Organizations such as Valley Conservation Council and the Virginia Outdoors Foundation are actively working with landowners in the area to place conservation easements on parcels of land. These organizations could serve as important partners in implementing this plan by helping to promote land conservation to producers, thereby lengthening the time over which water quality benefits occur in the streams due to the implementation of agricultural BMPs. Rockingham County is currently in the early stages of developing a Purchase of Development Rights program, which could help to provide the funding needed to assist landowners in placing easements on their property. No such local program is available in Augusta County; however, state tax credits are currently available for conservation easements.

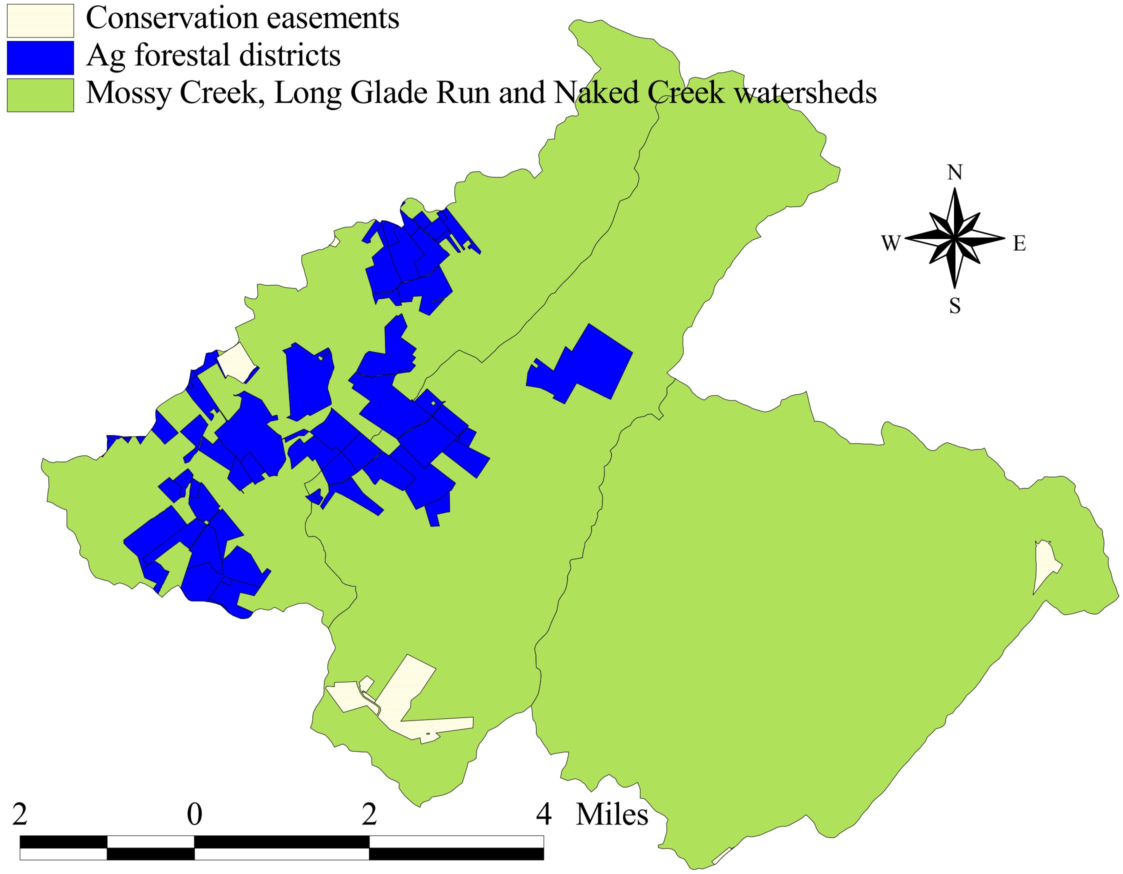

Figure 6.6 Conservation easements and ag forestal districts in the Mossy Creek, Long Glade Run and Naked Creek watersheds

The residential program that is currently being implemented by the Headwaters Soil and Water Conservation District prioritizes homes that are closest to the creeks for septic tank pumpouts, repairs and replacements.

7. STAKEHOLDERS AND THEIR ROLE IN IMPLEMENTATION

Achieving the goals of this plan is dependent on stakeholder participation and strong leadership on the part of both community members and conservation organizations. The Headwaters Soil and Water Conservation District has been targeting technical assistance and funding for best management practices in these watersheds since Summer 2006 implementing the agricultural BMPs through a cooperative grant agreement with the VA Department of Conservation and Recreation. In addition, the Headwaters Soil and Water Conservation District is currently working with the Augusta County Service Authority to implement a residential cost share program for septic system repairs and replacements. This effort is also funded through a grant agreement with the VA Department of Conservation and Recreation, and began in Fall 2007. VA Department of Conservation and Recreation staff will take the responsibility of working with Headwaters Soil and Water Conservation District and other partners in tracking implementation efforts and evaluating progress. The following sections in this chapter describe the responsibilities and expectations for the various components of implementation.

7.1 Voluntary Implementation Efforts

The majority of practices recommended in this plan are related to agriculture since it is the predominant land use in the watersheds. Participation from local farmers is thus a key factor to the success of this plan. Consequently, it is important to consider characteristics of farms and farmers in the watersheds that will affect the decisions farmers make when it comes to implementing conservation practices on their farms. For example, the average size of farms is an important factor to consider, since it affects how much land a farmer can give up for a riparian buffer. The age of a farmer, which was 57 in Virginia in 2007, may also influence their decision to implement best management practices, particularly if they are close to retirement and will be relying on the sale of their land for income during retirement. In such cases, it may be less likely that a farmer would be willing to invest a portion of their income in best management practices. Table 7.1 provides a summary of relevant characteristics of farmers and producers in Augusta and Rockingham Counties from the 2007 Agricultural Census. These characteristics were considered when developing implementation scenarios, and should be utilized to develop suitable education and outreach strategies.

Table 7.1 Characteristics of farms and farmers in Augusta and Rockingham Counties.

Characteristic	Augusta County	Rockingham County
Number of farms	1,729	1,970
Full owners of farms	1,118	1,183
Part owners of farms	652	514
Tenants	97	135
Owned land in farms (acres)	72,918	59,422
Rented land in farms (acres)	82,596	72,224
Operators identifying farming as their primary occupation	854	1,010
Operators identifying something other than farming as their primary occupation	732	780
Average size of farm (acres)	166	118
Average value of farmland ($/acre)	$4,897	$6,150
Average net cash farm income of operation ($)	$20,338	$67,892
Average farm production expenses ($)	$96,292	$209,779

In addition to local farmers, participation from homeowners is also critical to the success of this plan. Though the amount of bacteria that is coming from failing septic systems and straight pipes is minimal compared to livestock, human waste carries with it pathogens that can cause health problems above and beyond those associated with livestock waste.

7.2 Integration with Other Watershed Plans

Each watershed in the state is under the jurisdiction of a multitude of individual yet related water quality programs and activities, many of which have specific geographic boundaries and goals. These include but are not limited to TMDLs, Roundtables, Water Quality Management Plans, erosion and sediment control regulations, stormwater management, Source Water Protection Program, and local comprehensive plans.

Coordination of the implementation project with these existing programs could result in additional resources and increased participation.

7.3 Monitoring Water Quality

Improvements in water quality and implementation progress will be determined through monitoring conducted by the VA Department of Environmental Quality's ambient and biological monitoring programs. This program uses a variety of parameters to determine overall water quality status, but will focus on bacteria as the primary impairment of Mossy Creek, Long Glade Run and Naked Creek. Each stream will have one sampling site at a publicly accessible location which will be visited once a month by DEQ monitors. DEQ will also continue to monitor the biological health of Mossy Creek by sampling the benthic community in the Fall or Spring once a year. See Table 7.1 for a summary of the DEQ stations and their locations.

Other groups are also monitoring the streams. Friends of the Shenandoah River (FOSR) has a strong presence in the entire Shenandoah River Basin, including Augusta County. Their monitors collect water samples every other week which are tested for water column toxics, including metals and temperature, and then reported to DEQ. DEQ is able to use this data for listing and delisting streams as impaired in their biannual report to EPA. Thus far, all FOSR data in the three watersheds have shown the water quality to be fully supporting of aquatic life. Figure 7.1 shows the location of all monitoring stations in the watersheds.

Table 7.2 DEQ Monitoring Stations in the Mossy Creek, Long Glade Run and Naked Creek Watersheds.

Stream Name	Station ID	Location	Frequency	Type of Sampling
Mossy Creek	1BMSS001.35	Rt. 747 Bridge (Rock. Co.)	Monthly	Bacteria and Water Quality Parameters
Long Glade Run	1BLGC000.96	Rt. 727 Bridge	Monthly	Bacteria and Water Quality Parameters
Naked Creek	1BNKD000.80	Rt. 994 Bridge	Monthly	Bacteria and Water Quality Parameters
Mossy Creek	1BMSS003.01	Rt. 747 Bridge (Aug. Co.)	Fall/Spring	Biological Monitoring

Table 7.3 Friends of the Shenandoah River (FOSR) Monitoring Stations in the Mossy Creek, Long Glade Run and Naked Creek Watersheds.

Stream Name	Station ID	Frequency	Type of Sampling
Mossy Creek	1BMSS-JR05-FOSR	Every other week	Water Column Toxics
Long Glade Run	1BLGC-JR06-FOSR	Every other week	Water Column Toxics
Naked Creek	1BNKD-JA01-FOSR	Every other week	Water Column Toxics

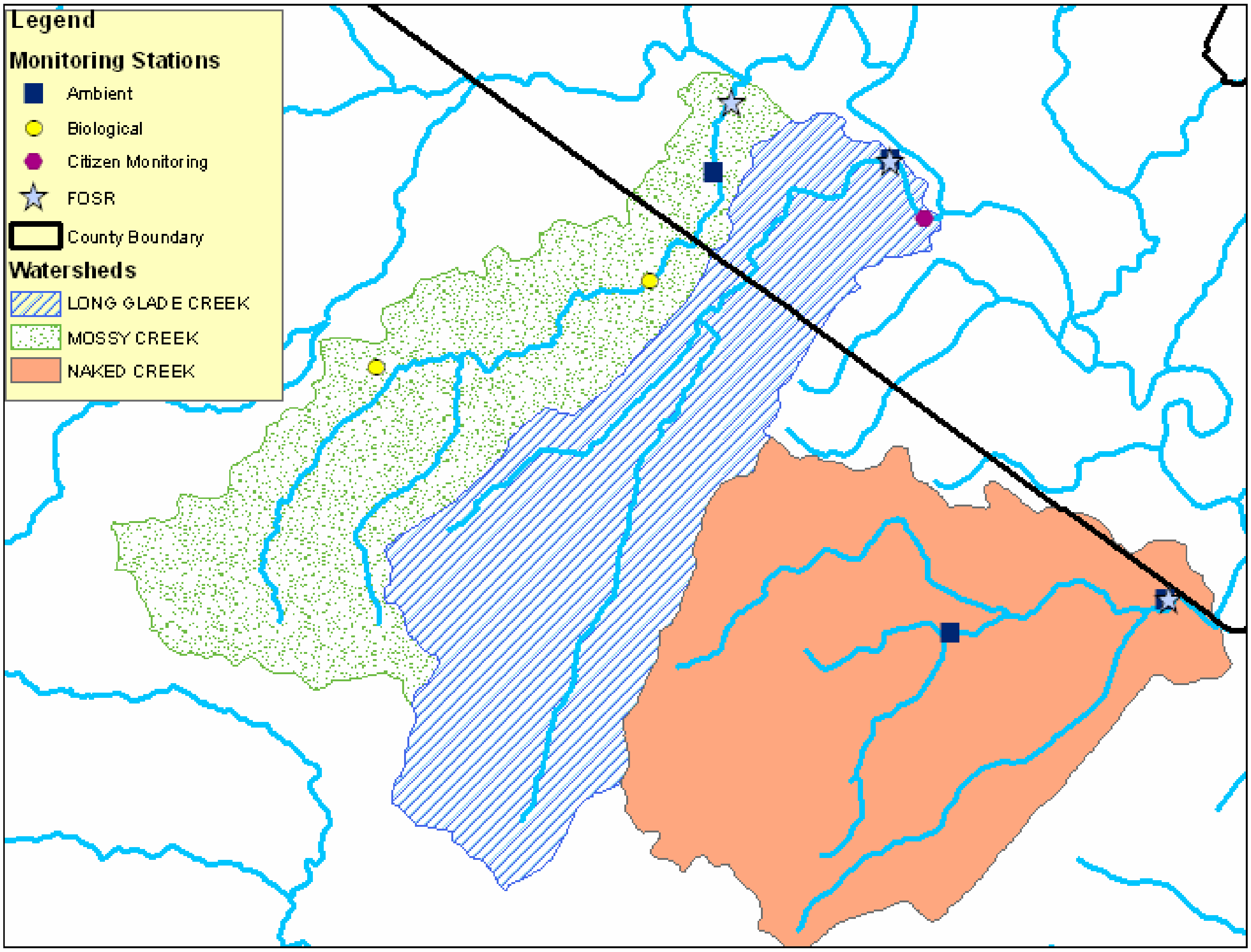

Figure 7.1 Mossy Creek, Long Glade Run and Naked Creek monitoring stations

In addition to surface water monitoring, it has been recommended that additional monitoring be conducted on sediment loading from the Mount Solon Spring. Sediment contributions from Freemason Run during storm events could be significant; however, sufficient data has not been collected to draw clear conclusions. During the spring study that took place in Mossy Creek in 2007, a model of the relationship between total suspended solids and water clarity rated using a turbidity tube was developed. This model will allow future research to be conducted at a very low cost. With assistance from the DCR Karst Program, it is possible that additional monitoring could be conducted.

7.4 Agricultural and Residential Education

Education and outreach is a significant component of any TMDL implementation project. The Headwaters Soil and Water Conservation District (SWCD) will be in charge of initiating contact with farmers to encourage the installation of BMPs. This one-on-one contact will facilitate communication of the water quality problems and the types of practices that could improve water quality. The district staff will conduct outreach activities in the watershed to encourage participation in conservation programs. Such activities include mailing out newsletters and organizing field days. The staff will work with other conservation organizations such as VA Cooperative Extension in these efforts. Specific agricultural and residential outreach ideas are outlined in section 5.3.

The Headwaters SWCD is a local government entity providing soil and water conservation assistance to farmers and residents of Augusta County. During the implementation project, the Headwaters SWCD will continue to provide outreach, technical and financial assistance to farmers and homeowners in the Mossy Creek, Long Glade Run and Naked Creek watersheds through the Virginia Agricultural BMP Cost-Share and Tax Credit programs. Their responsibilities include promoting available funding and the benefits of BMPs and providing assistance in the survey, design, layout, and approval of agricultural BMPs. Education and outreach activities are also a portion of their responsibilities.

A residential education program consisting of educational materials about pet waste and a pet waste digester program could be run through a partnership between the Headwaters SWCD, the Augusta County Service Authority and the Augusta County SPCA. These organizations could assist in the distribution of information on the importance of picking up after your pet including the potential for contamination of drinking water for homeowners with wells. The SPCA could provide new pet owners with information upon adopting a pet from the shelter, and provide pet waste digesters to customers if grant funding to purchase them was available.

7.5 Legal Authority

The EPA has the responsibility of overseeing the various programs necessary for the success of the CWA. However, administration and enforcement of such programs falls largely to the states. In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are four state agencies responsible for regulating activities that impact water quality in Virginia. These agencies are VADEQ, VADCR, VDH, and Virginia Department of Agriculture and Consumer Services (VDACS).

VADEQ has responsibility for monitoring waters to determine compliance with state standards, and for requiring permitted point dischargers to maintain loads within permit limits. It has the regulatory authority to levy fines and take legal action against those in violation of permits. Beginning in 1994, animal waste from confined animal facilities that hold in excess of 300 animal units (cattle and hogs) has been managed through a Virginia general pollution abatement permit. These operations are required to implement a number of practices to prevent surface and groundwater contamination. In response to increasing demand from the public to develop new regulations dealing with animal waste, the Virginia General Assembly passed legislation in 1999 requiring VADEQ to develop regulations for the management of poultry waste in operations having more than 200 animal units of poultry (about 20,000 chickens) (ELI, 1999).

VADCR holds the responsibility for addressing nonpoint sources (NPS) of pollution. Historically, most VADCR programs have dealt with agricultural NPS pollution through education and voluntary incentive programs. These cost-share programs were originally developed to meet the needs of voluntary partial participation and not the level of participation required by TMDLs (near 100%). To meet the needs of the TMDL program and achieve the goals set forth in the CWA, the incentive programs are continually reevaluated to account for this level of participation.

Through Virginia's Agricultural Stewardship Act (ASA), the Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis (Pugh, 2001). If deemed a problem, the

Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken which can include a civil penalty of up to $5,000 per day. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures. VDACS has only two staff members dedicated to enforcing the Agricultural Stewardship Act, and very little funding is available to support water quality sampling. The Agricultural Stewardship Act is entirely complaint-driven.

VDH is responsible for maintaining safe drinking water measured by standards set by the EPA. Their duties also include septic system regulation and, historically, regulation of biosolids land application on permitted farmland sites. Like VDACS, VDH's actions are complaint-driven. Complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation that may take many weeks or longer to effect compliance. In relation to these TMDLs, VDH has the responsibility of enforcing actions to correct or eliminate failed septic systems and straight pipes.

State government has the authority to establish state laws that control delivery of pollutants to local waters. Local governments, in conjunction with the state, can develop ordinances involving pollution prevention measures. In addition, citizens have the right to bring litigation against persons or groups of people shown to be causing some harm to the claimant. The judicial branch of government also plays a significant role in the regulation of activities that impact water quality through hearing the claims of citizens in civil court and the claims of government representatives in criminal court.

7.6 Legal Action

The Clean Water Act Section 303(d) calls for the identification of impaired waters. It also requires that the streams be ranked by the severity of the impairment and that TMDLs be calculated for streams to meet water quality standards. TMDL implementation plans are not required in the Federal Code; however, Virginia State Code does include the development of implementation plans for impaired streams. EPA largely ignored the nonpoint source section of the Clean Water Act until citizens began to realize that regulating only point sources was no longer maintaining water quality standards. Lawsuits from citizens and environmental groups citing EPA for not carrying out the statutes of the CWA began as far back as the 1970s and have continued until the present. In Virginia in 1998, the American Canoe Association and the American Littoral Society filed a complaint against EPA for failure to comply with provisions of §303d. The suit was settled by Consent Decree, which contained a TMDL development schedule through 2010. It is becoming more common for concerned citizens and environmental groups to turn to the courts for the enforcement of water quality issues.

Successful implementation depends on stakeholders taking responsibility for their role in the process. The primary role, of course, falls on the landowner. However, local, state and federal agencies also have a stake in ensuring that Virginia's waters are clean and provide a healthy environment for its citizens. An important first step in correcting the existing water quality problem is recognizing that there is a problem and that the health of citizens is at stake. Virginia's approach to correcting NPS pollution problems has been, and continues to be, encouragement of participation through education and financial incentives.

8. FUNDING

A list of potential funding sources available for implementation has been developed. A brief description of the programs and their requirements is provided in this chapter. Detailed descriptions can be obtained from the SWCD, VADCR, NRCS, and VCE.

Virginia Agricultural Best Management Practices Cost-Share Program

The cost-share program is funded with state and federal monies through local SWCDs. SWCDs administer the program to encourage farmers and landowners to use BMPs on their land to better control transportation of pollutants into our waters due to excessive surface flow, erosion, leaching, and inadequate animal waste management. Program participants are recruited by SWCDs based upon those factors, which have a great impact on water quality. Cost-share is typically 75% of the actual cost, not to exceed the local maximum.

Virginia Agricultural Best Management Practices Tax Credit Program

For all taxable years, any individual or corporation engaged in agricultural production for market, who has in place a soil conservation plan approved by the local SWCD, is allowed a credit against the tax imposed by Section 58.1-320 of an amount equaling 25% of the first $70,000 expended for agricultural best management practices by the individual. Any practice approved by the local SWCD Board must be completed within the taxable year in which the credit is claimed. The credit is only allowed for expenditures made by the taxpayer from funds of his/her own sources. The amount of the credit cannot exceed $17,500 or the total amount of the tax imposed by this program (whichever is less) in the year the project was completed. If the amount of the credit exceeds the taxpayer’s liability for such taxable year, the excess may be carried over for credit against income taxes in the next five taxable years until the total amount of the tax credit has been taken. This program can be used independently or in conjunction with other cost-share programs on the stakeholder’s portion of BMP costs. It is also approved for use in supplementing the cost of repairs to streamside fencing.

Virginia Agricultural Best Management Practices Loan Program

Loan requests are accepted through VADEQ. The interest rate is 3% per year and the term of the loan coincides with the life span of the practice. To be eligible for the loan, the BMP must be included in a conservation plan approved by the local SWCD Board. The minimum loan amount is $5,000; there is no maximum limit. Eligible BMPs include 23 structural practices such as animal waste control facilities, loafing lot management systems, and grazing land protection systems. The loans are administered through participating lending institutions.

Virginia Small Business Environmental Assistance Fund Loan Program

The Fund, administered through VADEQ, is used to make loans or to guarantee loans to small businesses for the purchase and installation of environmental pollution control equipment, equipment to implement voluntary pollution prevention measures, or equipment and structures to implement agricultural BMPs. The equipment must be needed by the small business to comply with the federal Clean Air Act, or it will allow the small business to implement voluntary pollution prevention measures. The loans are available in amounts up to $50,000 and will carry an interest rate of 3%, with favorable repayment terms based on the borrower's ability to repay and the useful life of the equipment being purchased or the life of the BMP being implemented. There is a $30 non-refundable application processing fee. The Fund will not be used to make loans to small businesses for the purchase and installation of equipment needed to comply with an enforcement action. To be eligible for assistance, a business must employ 100 or fewer people and be classified as a small business under the federal Small Business Act.

Virginia Water Quality Improvement Fund

This is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint nutrient loads to surface waters. Eligible recipients include local governments, SWCDs, and individuals. Grants for point sources are administered through VADEQ and grants for nonpoint sources are administered through VADCR. Most WQIF grants provide matching funds on a 50/50 cost-share basis. A grant through this fund is currently supporting the septic system program that is administered by the Headwaters SWCD and the Augusta County Service Authority.

Conservation Reserve Program (CRP)

Through this program, cost-share assistance is available to establish cover of trees or herbaceous vegetation on cropland. Offers for the program are ranked, accepted and processed during fixed signup periods that are announced by FSA. If accepted, contracts are developed for a minimum of 10 and not more than 15 years. Payments are based on a per-acre soil rental rate. To be eligible for consideration, the following criteria must be met: 1) cropland was planted or considered planted in an agricultural commodity for two of the five most recent crop years, and 2) cropland is classified as "highly-erodible" by NRCS. Application evaluation points can be increased if certain tree species, spacing, and seeding mixtures that maximize wildlife habitats are selected. Land must have been owned or operated by the applicant for at least 12 months prior to the close of the signup period. The payment to the participant is up to 50% of the cost for establishing ground cover. Incentive payments for wetlands hydrology restoration equal 25% of the cost of restoration.

Conservation Reserve Enhancement Program (CREP)

This program is an "enhancement" of the existing USDA CRP Continuous Sign-up. It has been "enhanced" by increasing the cost-share rates from 50% to 75% and 100%, increasing the rental rates, and offering a flat rate incentive payment to place a permanent "riparian easement" on the enrolled area. Pasture and cropland (as defined by USDA) adjacent to streams, intermittent streams, seeps, springs, ponds and sinkholes are eligible to be enrolled. Buffers consisting of native, warm-season grasses on cropland, to mixed hardwood trees on pasture, must be established in widths ranging from the minimum of 30% of the floodplain or 35 feet, whichever is greater, to a maximum average of 300 feet. Cost-sharing (75% - 100%) is available to help pay for fencing to exclude livestock from the riparian buffer, watering facilities, hardwood tree planting, filter strip establishment, and wetland restoration. In addition, a 40% incentive payment upon completion is offered and an average rental rate of $70/acre on stream buffer area for 10-15 years. The State of

Virginia will make an additional incentive payment to place a perpetual conservation easement on the enrolled area.

The landowner can obtain and complete CREP application forms at the FSA center. The forms are forwarded to local NRCS and SWCD offices while FSA determines land eligibility. If the land is deemed eligible, NRCS and the local SWCD determine and design appropriate conservation practices. A conservation plan is written, and fieldwork is begun, which completes the conservation practice design phase.

FSA then measures CREP acreage, conservation practice contracts are written, and practices are installed. The landowner submits bills for cost-share reimbursement to FSA. Once the landowner completes BMP installation and the practice is approved, FSA and the SWCD make the cost-share payments. The SWCD also pays out the state's one-time, lump sum rental payment. FSA conducts random spot checks throughout the life of the contract, and the agency continues to pay annual rent throughout the contract period.

Environmental Quality Incentives Program (EQIP)

This program was established in the 1996 Farm Bill to provide a single voluntary conservation program for farmers and landowners to address significant natural resource needs and objectives. Approximately 65% of the EQIP funding for the state of Virginia is directed toward “Priority Areas.” These areas are selected from proposals submitted by a locally led conservation work group. Proposals describe serious and critical environmental needs and concerns of an area or watershed, and the corrective actions they desire to take to address these needs and concerns. The remaining 35% of the funds are directed toward statewide priority concerns of environmental needs. EQIP offers 5 to 10-year contracts to landowners and farmers to provide 75% cost-share assistance, 25% tax credit, and/or incentive payments to implement conservation practices and address the priority concerns statewide or in the priority area. Eligibility is limited to persons who are engaged in livestock or agricultural production. Eligible land includes cropland, pasture, and other agricultural land in priority areas, or land that has an environmental need that matches one of the statewide concerns.

Wildlife Habitat Incentive Program (WHIP)

WHIP is a voluntary program for landowners who want to develop or improve wildlife habitat on private agricultural lands. Participants work with NRCS to prepare a wildlife habitat development plan. This plan describes the landowner's goals for improving wildlife habitat and includes a list of practices and a schedule for installation. A 10-year contract provides cost-share and technical assistance to carry out the plan. In Virginia, these plans are prepared to address one or more of the following high priority habitat needs: early grassland habitats that are home to game species such as quail and rabbit as well as other non-game species like meadowlark and sparrows; riparian zones along streams and rivers that provide benefits to aquatic life and terrestrial species; migration corridors which provide nesting and cover habitats for migrating songbirds, waterfowl and shorebird species; and decreasing natural habitat systems which are environmentally sensitive and have been impacted and reduced through human activities. Cost-share assistance of up to 75% of the total cost of installation (not to exceed $10,000 per applicant) is available for establishing habitat. Types of practices include: disking, prescribed burning, mowing, planting habitat, converting fescue to warm season grasses, establishing riparian buffers, creating habitat for waterfowl, and installing filter strips, field borders and hedgerows. For cost-share assistance, USDA pays up to 75% of the cost of installing wildlife practices.

Wetland Reserve Program (WRP)

This program is a voluntary program to restore and protect wetlands on private property. The program benefits include providing fish and wildlife habitat, improving water quality, reducing flooding, recharging groundwater, protecting and improving biological diversity, and furnishing recreational and esthetic benefits. Sign-up is on a continuous basis. Landowners who choose to participate in WRP may receive payments for a conservation easement or cost-share assistance for a wetland restoration agreement. The landowner will retain ownership but voluntarily limits future use of the land. The program offers landowners three options: permanent easements, 30-year easements, and restoration cost-share agreements of a minimum 10-year duration. Under the permanent easement option, landowners may receive the agricultural value of the land up to a maximum cap and 100% of the cost of restoring the land. For the 30-year option, a landowner will receive 75% of the easement value and 75% cost-share on the restoration. A ten-year agreement is also available that pays 75% of the restoration cost. To be eligible for WRP, land must be suitable for restoration (formerly wetland and drained) or connect to adjacent wetlands. A landowner continues to control access to the land and may lease the land for hunting, fishing, or other undeveloped recreational activities. At any time, a landowner may request that additional activities be added as compatible uses. Easement participants must have owned the land for at least one year.

Southeast Rural Community Assistance Project (SE/R-CAP)

The mission of this project is to promote, cultivate, and encourage the development of water and wastewater facilities to serve low-income residents at affordable costs and to support other development activities that will improve the quality of life in rural areas. Staff members of other community organizations complement the SE/R-CAP staff across the region. They can provide (at no cost): on-site technical assistance and consultation, operation and maintenance/management assistance, training, education, facilitation, volunteers, and financial assistance. Financial assistance includes $1,500 toward repair/replacement/ installation of a septic system and $2,000 toward repair/replacement/installation of an alternative waste treatment system. Funding is only available for families making less than 125% of the federal poverty level.

National Fish and Wildlife Foundation

Grant proposals for this funding are accepted throughout the year and processed during fixed signup periods. There are two decision cycles per year. Each cycle consists of a pre-proposal evaluation, a full proposal evaluation, and a Board of Directors' decision. Grants generally range between $10,000 and $150,000. Grants are awarded for the purpose of conserving fish, wildlife, plants, and their habitats. Special grant programs are listed and described on the NFWF website (http://www.nfwf.org). If the project does not fall into the criteria of any special grant programs, a proposal may be submitted as a general grant if it falls under the following guidelines: 1) it promotes fish, wildlife and habitat conservation, 2) it involves other conservation and community interests, 3) it leverages available funding, and 4) project outcomes are evaluated.

Clean Water State Revolving Fund

EPA awards grants to states to capitalize their Clean Water State Revolving Funds (CWSRFs). The states, through the CWSRF, make loans for high-priority water quality activities. As loan recipients make payments back into the fund, money is available for new loans to be issued to other recipients. Eligible projects include point source, nonpoint source and estuary protection projects. Point source projects typically include building wastewater treatment facilities, combined sewer overflow and sanitary sewer overflow correction, urban stormwater control, and water quality aspects of landfill projects. Nonpoint source projects include agricultural, silvicultural, rural, and some urban runoff control; on-site wastewater disposal systems (septic tanks); land conservation and riparian buffers; leaking underground storage tank remediation, etc.

Wetland and Stream Mitigation Banking

Mitigation banks are sites where aquatic resources (wetlands, streams, and associated buffers) are restored, created, enhanced, or in exceptional circumstances, preserved expressly for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources. Mitigation banking is a commercial venture which provides compensation for aquatic resources in financially and environmentally preferable ways. Not every site or property is suitable for mitigation banking. Wetlands and streams are complex systems, and their restoration, creation, enhancement, or preservation often requires specialized ecological and engineering knowledge. Likewise, the mitigation banking process requires experience to efficiently navigate. Mitigation banks are required to be protected in perpetuity, to provide financial assurances, and long term stewardship. The mitigation banking processes is overseen by the Inter-Agency Review Team (IRT) consisting of several state and federal agencies and chaired by DEQ and Army Corps of Engineers. For more information, contact the Army Corps of Engineers or VADEQ's Virginia Water Protection Program.

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